POWER

Volume 65 New York, June 28, 1927 Number 26

Savings Possible in Power Plants

IF SOMEBODY should come along and offer you $10,000, would you say "No, I thank you. That is less than one per cent of my gross business; not worth bothering about."?

And yet this is the attitude of many managers with respect to their power plants.

It is true that the expenditure for power in many industries amounts to less than five per cent of the total cost.

But suppose twenty per cent of that five per cent can be saved, as it undoubtedly can in a great number of instances.

The pages of *Power* are full of examples of savings greater than this. The industries are full of plants susceptible to such improvement.

This would amount to a saving of one per cent of the total cost. And if dividends bear a fair relation to the total turnover, it would mean a considerable increase in the dividend rate.

Why, then, is it not worth the consideration of an intelligent manager?

While it is true that the power cost in many industries is small, the combined cost of power and of steam for heating and manufacturing processes is often considerable.

And where there is sufficient use for steam for other than power purposes, the power may be had practically as a byproduct.

What would be thought of a manufacturer who had a water supply under a head of a hundred or more feet, and who throttled it into his tubs and vats instead of putting it through a waterwheel and making with it the power for which he would otherwise have to burn coal or spend money, and using the outflow of his waterwheel for washing, etc.?

The exhaust of a non-condensing steam turbine is uncontaminated and carries some ninety per cent of the heat put into it by the boiler.

Advances in the boiler art have made it possible to generate steam at any pressure desired, and turbines are available that will operate at high pressures and exhaust against any desired back pressure.

The steam from such a turbine may be given any degree of dryness or superheat desired, and the bleeder type will deliver what is needed for processing and work the rest through the condenser.

There are great possibilities in it. Think it over!

F. R. Low

Power Station for New Panhandle Oil Field

By J. A. KEETH

IN THIS field electric power from a central plant for the drilling and pumping of oil wells was considered preferable to the use of steam or gas in individual plants. Cheap fuel in the form of wet gas with the casing-head gasoline extracted, prohibited expensive refinements. Steam is bled to heat the feed water and combustion air is preheated in hollow furnace walls. Cost of circulating water was a paramount issue.

IN JULY, 1926, a new power company was organized in the State of Texas under the name of the Panhandle Power & Light Company, for the primary purpose of furnishing electric power for the drilling and pumping of oil wells in the new Panhandle Field. Many of the large operators in this field believed that electric power for oil production was preferable to steam or gas, and their contracts for power with the new company practically assured the success of the project. However, one of the primary requisites in securing these contracts was that the proposed station should be in commercial operation within 120 days from the date of the signing of the first power contract on July 21, 1926.

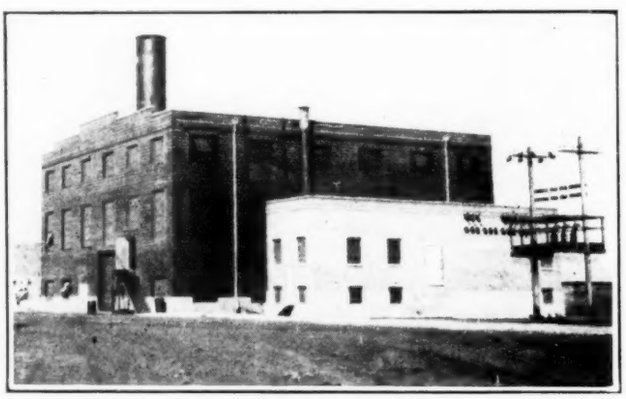


Fig. 1—View of station exterior

The acceptance of such a schedule imposed tremendous difficulties. The nearest railroad was 30 miles away, with only the crudest of dirt roads to the plant site. The roads became impassable during many of the rainstorms that occurred during the plant construction. To overcome the inability of manufacturers to make satisfactory delivery on much of the equipment required, part of the machinery installed had to be taken from other sources. Through the co-operation of the holding company, the Kansas City Power Securities Corp., equipment was taken from one of their stand-by stations, storerooms and other places to supply the needs where new equipment could not be secured in time.

Fig. 2—Spray pond for cooling the circulating water

When the engineers decided to undertake the task in the specified time, they had the promise that the railroad, then building, would be finished to within three miles of the plant site in thirty days. Rains delayed this work and no freight was handled over the rails until within about fifteen days of the time set for completing the plant. In the face of all these and many other difficulties the plant was completed in slightly under the stipulated time and has been in commercial operation since Nov. 20, 1926.

Since its incorporation the company has extended its activities into the gas and water business and through the purchase of the Borger Townsite Co. and the gas and electric properties of the Borger Gas & Electric Co., is now furnishing electric light and power, gas and water services to the towns of Borger, Isom, Dixon Creek, Phillips and Whittenberg. Franchises have been obtained in seven counties, and several towns in these counties will soon be served by this plant. However, the power used in the development of the oil fields and the pumping will continue to be the chief demand on the station. The pumping, as well as the drilling load, is practically continuous 24 hours a day, thus resulting in an excellent load factor.

Fig. 1 is a view of the station exterior. A general idea of the surrounding country may be obtained from Fig. 2, in which it will be noticed that a spray pond is utilized for cooling the circulating water. There is practically no surface water in this section of the country, near-by wells supplying the water for the pond. This water is unsuited for boiler feed and cannot be treated chemically. The boiler makeup water is brought in from a distance of 16 miles from deep wells belonging to the Phillips Petroleum Co. Treated, this water makes an excellent boiler feed. The cost of water is one of the chief items in the production cost, and for that reason economy in water consumption was a paramount issue in the plant design. Unusually large spaces have been left between the edges of the spray pond and the nearest nozzles to minimize the amount of drift loss. All water used in the station for oil coolers, bearings, etc., is returned to the pond, sprayed and used over again.

In the Panhandle Oil Field are the largest casing-head gasoline plants in the world. The wet well gas, after extraction of this casing-head gasoline, is the fuel used at the power station. It is high in heat value and low in cost. Because of the cheap fuel available, an effort was made in the design of the plant to strike the proper balance between plant cost and power production cost. The installation of expensive, high-economy equipment could not be justified with the low fuel costs. The equipment installed is modern in every detail and is felt to be that best suited to the conditions.

Because of the extreme high winds prevailing in that district, a short stack with induced-draft fans supplants the high chimney. With a minimum duplication of equipment continuous operation has been assured through cross-connections between fans, pumps, etc.

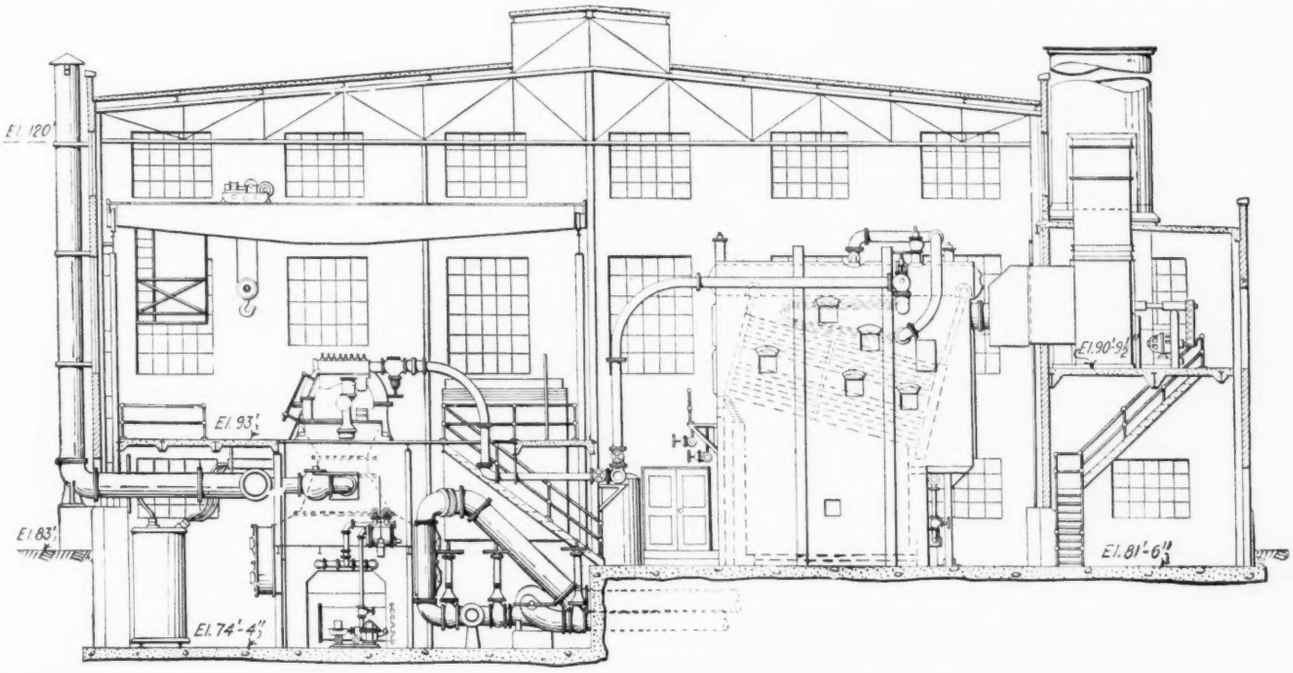


Fig. 3—Cross-section through turbine and boiler room

Sufficient steam auxiliaries are provided to start the station without an outside source of power. Stage bleeding of the turbines along with steam from auxiliaries provides the necessary heat for feed water without the use of economizers.

The present boiler equipment comprises two 5,250-sq.ft. horizontal water-tube boilers and two 5,520-sq.ft. Stirling boilers, all equipped with superheaters and designed for operation at 200 lb. gage and 150 deg. F. superheat. Two of the boilers are provided with low-pressure gas burners and two with high-pressure burners. Large furnaces have been provided, constructed with hollow walls serving the double purpose of reducing brickwork maintenance and heating the air for combustion. Boilers and furnaces are designed for a maximum rating of 250 per cent.

In the turbine room are two generating units, one rated at 500 kva. and the other at 7,500 kva., both equipped with surface condensers and steam air ejectors. Power is generated at 13,200 volts, which is also the present distribution voltage. Longer lines

under construction will be at higher voltage. The switchboard for the control of the generators as well as the feeders is in the turbine room.

In Fig. 3, a section through the main plant building, it will be noticed that there is no partition wall between the turbine room and boiler room. Gas firing, of course, makes this possible. The general layout of piping is accessible and simplifies the operation of the plant.

The buses and oil switches are in a building separate from the main plant, but connected by a short bridge from the turbine-room floor. A monolithic concrete bus and switch cell structure is used. The generators are connected by switches to the main and transfer buses. Feeder switches are provided on the main bus only with double-throw disconnects for connecting the feeders either to the main or to the transfer bus. All the switches are controlled from the main turbine-room switchboard.

The load has built up so rapidly that the initial part of the station was in operation only a little over two months before work was started on an addition comprising two more boilers and a third turbine of 7,500 kva. capacity. The entire design of the station was made under the direction of Edwin Jowett, vice-president of the Kansas City Power & Light Co. and the Panhandle Power & Light Co.

DATA ON MECHANICAL EQUIPMENT IN BORGER PLANT OF PANHANDLE POWER & LIGHT COMPANY

BOILERS:
- 2—5,250-sq.ft. Babcock & Wilcox with B. & W. convection superheaters.
  Center of drums 26 ft. above boiler room floor.
  Furnace volume per boiler 1,811.25 cu.ft.
- 2—5,220-sq.ft. Stirling boilers with Stirling convection superheaters.
  Center of drums 26 ft. above floor.
  Furnace volume per boiler 1,620 cu.ft.

GAS BURNERS:
- B. & W. boilers each equipped with No. 3 Combustion Engineering multiple-jet gas burners.
- Stirling boilers each equipped with three Bendster high-pressure gas burners.

DRAFT EQUIPMENT:
- Stack—One 9x65-ft. guyed steel stack. Top of stack 83 ft. above gas burners.
- 2—No. 13 American Blower induced-draft fans, each capable of handling 110,000 cu.ft. of gas per min. with a maximum draft at fan inlet of 1¾ in. of water.

BOILER-FEED PUMPS:
- 1—Allis-Chalmers motor-driven hydrocone pump of 400 g.p.m. capacity against a total head of 210 lb.
- 1—Worthington 10x4½x10-in. duplex steam pump.

FEED-WATER HEATERS:
- 2—Worthington 30,000-lb. open heaters.
- 1—Elliott 325-sq.ft. closed heater.

FEED-WATER TREATING PLANT:
- 1—Permutit double-tank zeolite treating plant rated at 2,000 gal. per 8 hours with 77 grain water.

TURBINES:
- 1—4,000-kw. General Electric turbo-alternator, 3,600 r.p.m.
- 1—6,000-kw. Westinghouse turbo-alternator, 3,600 r.p.m.

HOUSE SERVICE PUMPS:
- 1—Janesville centrifugal pump driven by Terry turbine. Pump designed for 200 g.p.m. against a total head of 75 lb.
- 1—Worthington 300-g.p.m., 75-lb. pressure, motor-driven centrifugal pump.

CONDENSERS:
- 1—Wheeler Condenser and Engineering Co. 8,000-sq.ft. surface type equipped with:
  - 1—Worthington 10,000-g.p.m. horizontal circulating pump driven by a General Electric 160-hp. turbine and reduction gear.
  - 1—Worthington two-stage 160 g.p.m. hotwell pump driven by Terry turbine.
  - 1—Wheeler C. & E. Co., steam jet air pump of the two-stage type equipped with surface inter and after condenser. Capacity of jets at 28 in. vacuum, 25 cu.ft. free air per min.
- 1—Westinghouse 11,000-sq.ft. surface type condenser equipped with:
  - 1—Westinghouse 11,000-g.p.m. horizontal circulating pump driven by 200-hp. motor.
  - 1—Westinghouse steam air ejector of the two-stage type equipped with surface inter and after condenser. Capacity of jets at 28 in. vacuum, 30 cu.ft. free air per min.
  - 1—Westinghouse motor-driven two-stage hotwell pump. Capacity 160 g.p.m.

EXTRACTION HEATER CONDENSATE PUMP:
- 1—Allis-Chalmers motor-driven centrifugal pump designed for 60 g.p.m. against a head of 60 ft.

SUMP PUMP:
- 1—Worthington motor-driven vertical type sump pump designed for 200 g.p.m. against a head of 50 ft.

MAKEUP:
- 1—Allis-Chalmers motor-driven centrifugal pump designed for 115 g.p.m. against a head of 70 ft.

TURBINE-ROOM CRANE:
- 1—35-ton Harnishfeger Corp., electric-driven bridge crane, 42-ft. span.

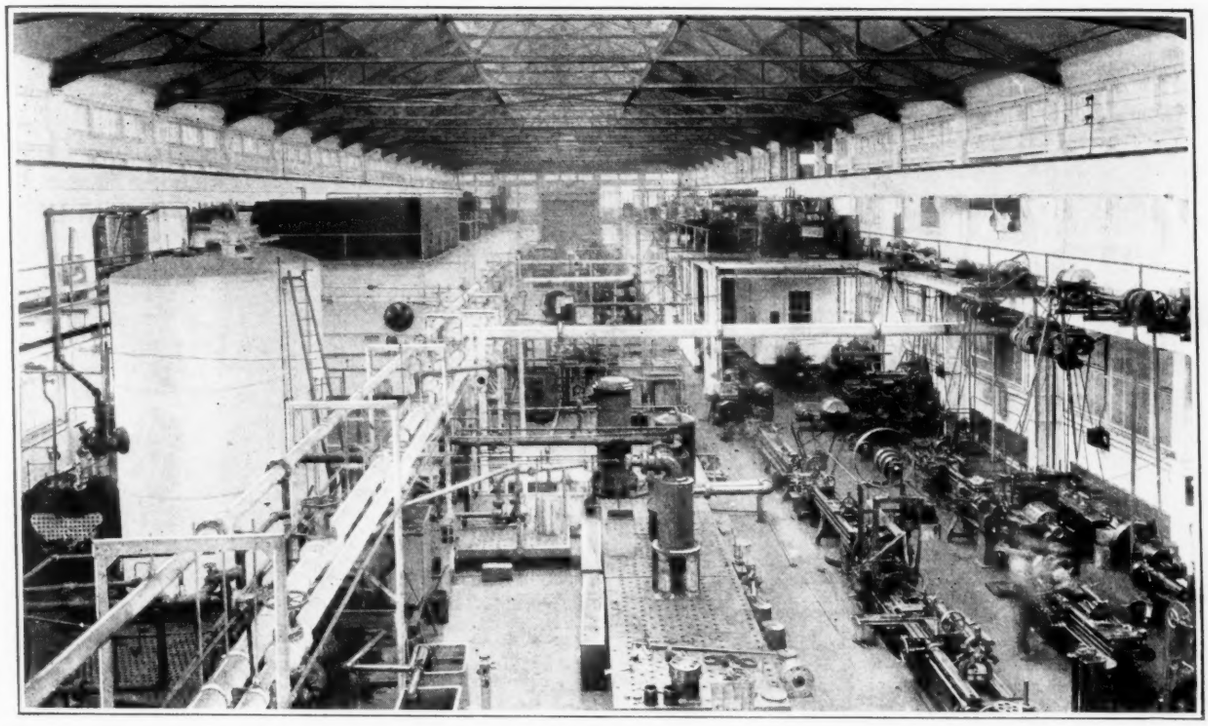
SPRAY POND:
- 1—Concrete basin 140 ft. wide, 325 ft. long by 4 ft. deep, equipped with Marley spray equipment consisting of fifty groups of five 2-in. Marley nozzles with all connecting piping. Pond is designed for 10,000 g.p.m. and is so piped that it can serve either unit but not both.

Diesel Bids at Ponca City, Oklahoma

Ponca City, Oklahoma, has been forced to increase the capacity of its municipal light plant. At present there are two Diesel engines in service in conjunction with a steam plant. The plant will be removed to a new locality, the steam machinery abandoned and two new Diesel units added. Bids were opened on March 31 for the engines and other equipment, the bids of the several engine builders appearing in the table. These contemplate the furnishing of two engines, without generator, exciter, etc. Prices are f.o.b. factory. The contract was awarded to the Nordberg Manufacturing Co., which company supplied the two units in the present Ponca City plant. As will be seen from the table the bids were unusually close.

DIESEL ENGINE BIDS AT PONCA CITY, OKLA., MARCH 31, 1927

Bidders	Worthington	Worthington	Worthington	De La Vergne	Nordberg	McIntosh	Busch	Fulton
Size engines, b.h.p.	2-1,250	2-1,500	1-1,250 and 1-1,500	2-1,250	2-1,250	2-1,250	2-1,250	2-1,150
No. cylinders	5	6	5 and 6	6	5	6	6	6
Bore and stroke, in.	16x24	16x24	16x24	22x30	20¼x26	23x32	17x27	23x29
Cycle	2-cycle double acting			4	2	4	2	4
R.p.m.	200	200	200	200	180	164	200	164
Piston speed, ft. per min.	800	800	800	1,000	780	875	900	806
Type injection	Air	Air	Air	Pump	Air	Air	Air	Air
Price of two engines	$151,500	$180,000	$166,250	$123,115	$147,000	$143,083	$129,575	$148,760
F.o.b. point	Factory	Factory	Factory	Factory	Factory	Factory	Factory	Factory
Price per hp.	$60.50	$60.00	$60.50	$49.25	$58.75	$57.25	$50.00	$64.75



Looking down aisle of main building with mechanical laboratory and machine shop in foreground

U. S. Naval Experiment Station an Aid to Industry

By CAPTAIN H. C. DINGER, U. S. N., Officer-in-Charge

THE United States Naval Engineering Experiment Station, at Annapolis, Maryland, has been in operation since 1907. Although its primary purpose is to perform testing work for the Naval Bureau of Engineering, it also tests apparatus submitted by manufacturers to determine actual performance and to ascertain its suitability for use in the Navy or other government service. In all testing work the utilitarian aspect of the results are kept in view, and the Department's policy recognizes that information based on tests at the Station may be of value not only to the government, but also to industry in general. In fact, some of the results may be of comparatively little interest to naval work, but may be of great value to certain industries or to the general advancement of science. As now organized, the Experiment Station has three laboratories: Mechanical, Metallurgical and Chemical.

AN EDITOR of Power recently visited Captain Dinger at the Naval Engineering Experiment Station and was conducted through the laboratories. The facilities of the Station and the scope of the tests under way were most illuminating. That these facilities are available for the testing of commercial apparatus is probably not widely known, nor is the co-operative spirit of the Navy Department toward industry fully appreciated. This is especially important to manufacturers who have no testing facilities of their own. Therefore, Captain Dinger has kindly consented to outline briefly in the accompanying article the work of the Experiment Station.

The Mechanical Laboratory is engaged chiefly in testing mechanical apparatus of various kinds submitted by manufacturers. This includes:

Pumps for boiler feed, oil service, water service, condensate, etc., together with their driving turbines:

Pump-control apparatus. Air pumps and air ejectors.

Steam traps.

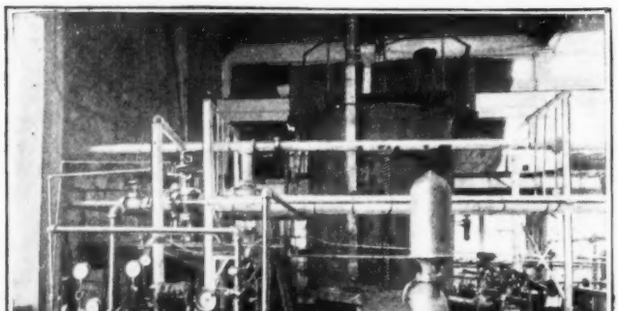
Power-plant instruments, such as recording gages, flow meters, etc.

Thermometers and heat-measuring apparatus.

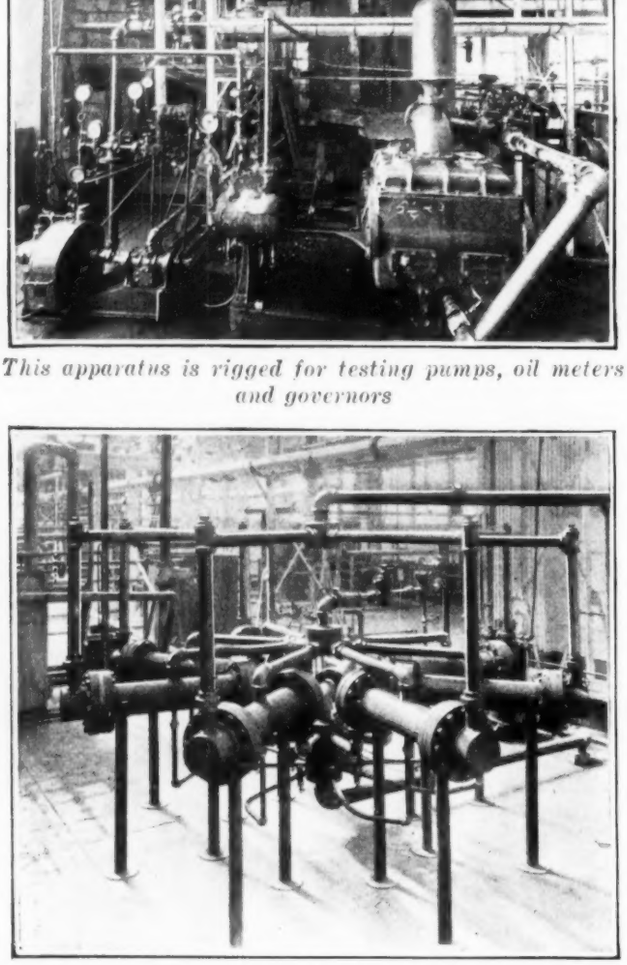
Heating apparatus, radiators, thermo tanks, etc.

Heat transfer apparatus, feed and oil heaters, oil coolers, evaporators, distillers and other heat exchangers.

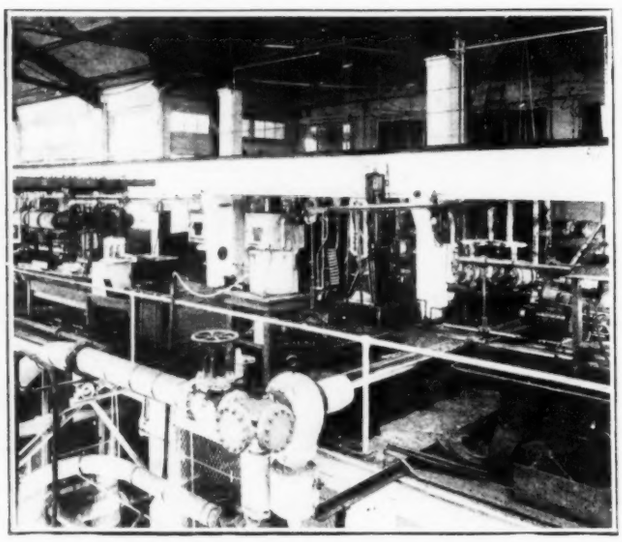
Oil purifiers.



This apparatus is rigged for testing pumps, oil meters and governors



In these sections are placed banks of condenser tubes of different compositions. They are constantly under water and steam approximating service conditions



Apparatus for testing packing of all kinds

Valves, expansion joints and other fittings used in connection with steam, water and oil systems on board ship.

Condensers and condenser materials.

Materials for valve trim, steam nozzles and other special purposes.

Refrigerating machines for shipboard use.

The laboratory also develops specifications and revision of specifications for the foregoing classes of apparatus. Its personnel is called upon occasionally to make tests of apparatus after installation on naval vessels. A further field of activity is that of making routine tests to determine suitability for acceptance lists and check tests in connection with the procurement of coal, spark plugs, taps and dies, ball bearings and grinding compounds.

Chemical Laboratory

This covers a special field of engineering supplies, which are tested and the requirements of which are set forth through the Station's activity. This involves tests to determine suitability for acceptable lists, check tests in connection with procurement and tests and investigations for the preparation and revision of specifications and requirements. The following are the principal lines covered:

Fuel oil.

Lubricating oils and greases, including aviation oil.

Packings and gaskets of all kinds.

Heat-insulation materials.

Rust preventives.

Washing and cleaning materials.

Boiler compound and feed-water treatment.

Gage glasses.

Corrosion deterrents of various kinds.

Metals Laboratory

This laboratory covers:

Metallographic examination of steel forgings submitted for use by the Navy, including shafting, blading materials, tubing, plates, etc.

Investigation of properties of various alloy steels and non-ferrous materials for possible naval use.

Investigation and tests to determine improved methods and processes for production and working of metals.

Tests and investigations incident to preparation and revision of specifications for metal products such as forgings, tubing, bearing metals, boiler and condenser tubes, plates, shapes, castings, etc.

Special tests in connection with work of American Society for Testing Materials.

General investigation of corrosion fatigue phenomena for both ferrous and non-ferrous materials.

Investigation of breakages, fractures and other metal failures that develop from time to time.

Information to the Service in regard to application of metallurgical knowledge and data in various fabrication and construction processes.

Advice to Operating Service

Any ship, naval station or other activity, having a particular problem or difficulty within the scope of the Station's activities may write for advice. The Station, after due investigation, makes a reply, sending a copy to the Bureau of Engineering. If the request entails any extensive test or is beyond the scope of the Station, the matter is referred to the Bureau of Engineer-

ing for appropriate action. Many of these inquiries refer to lubricants and packings and the suitability of various metals for particular uses or are requests for information as to why defects or failures have occurred. The information and advice given are really in the nature of expert consulting work, which on occasions is also performed for other government agencies, such as the War Department, Coast Guard and Shipping Board.

The Station prepares pertinent notes of particular developments of interest to the Service, and these are published in the *Engineering Bulletin*, issued periodically by the Bureau of Engineering. In this way such information is authoritatively and expeditiously transmitted to the Service, where it may be applied.

There is also issued a monthly report of the status of all tests, together with a list of new tests authorized during the month and a list of tests reported upon.

Among the special problems now being studied are: Corrosion and deterioration of materials and the development of preservatives and methods for preventing and arresting corrosion; industrial cleaning problems as applied to the Navy; improved methods of casting and heat-treating steel; application and use of new ferrous and non-ferrous alloys; and development of light and efficient auxiliary machinery for shipboard use.

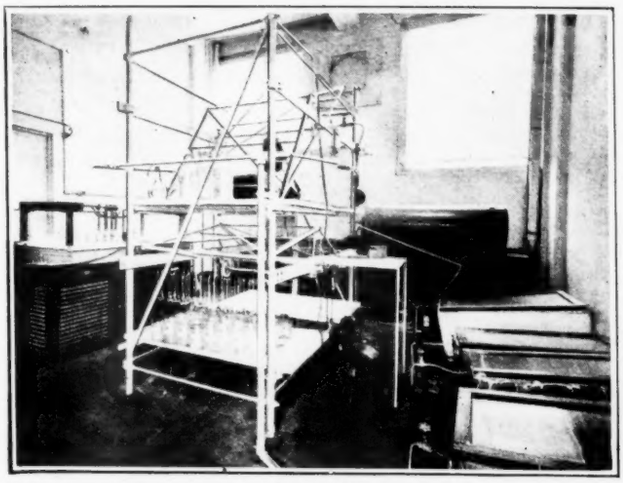
Procurement and Inspection of Supplies and Material

Tests are made to determine the suitability of various materials for placing on Navy acceptable lists. Also for certain periodic contracts, bidders' samples are tested and the report of performance is used as a basis for awarding contracts. Still another service is that of testing samples selected by inspectors from deliveries. Furthermore, in the case of lubricating oil samples in use are sent in so that the actual condition of oils in service can be determined.

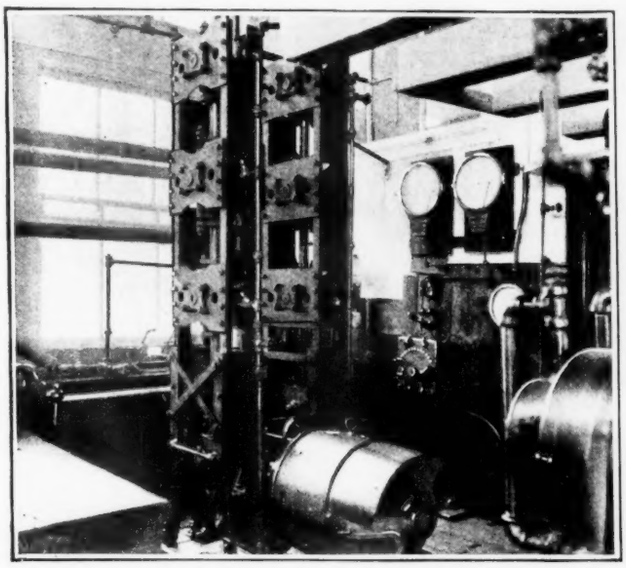
The Station has developed the metallographic requirements for steel forgings, boiler and condenser tubes and other special material. It has greatly reduced the cost of fuel oil, lubricants, packing, gage glasses, coal, spark plugs, taps and dies, boiler compound, rust preventives, cleaning materials, and at the same time insured that the Navy was being supplied with the best quality of these materials that could be obtained commercially. This action also is continually spurring on manufacturers to improve their product and to secure more economical production.

Tests for Manufacturers

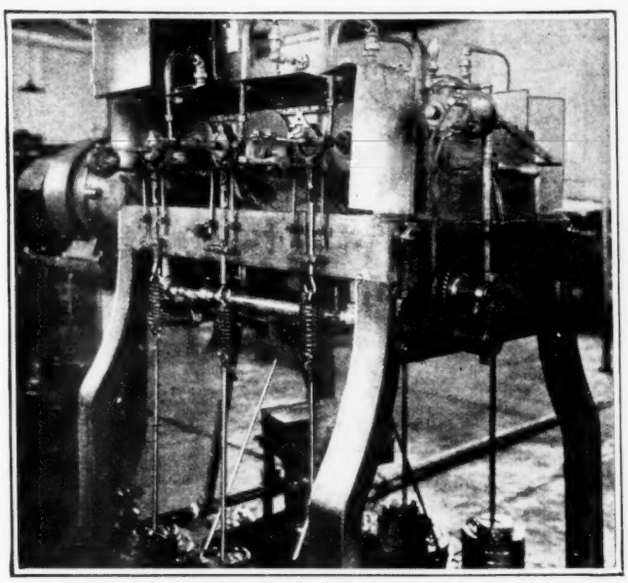
Manufacturers who are developing new designs of apparatus can have these exhaustively tested by securing authority to have tests made, a fee covering the actual material and labor cost of the test being charged. Indirect expenses are not included so that the testing charge is really somewhat less than the actual cost. The government benefits by the experience and information obtained from the test. The manufacturer has the opportunity to have his apparatus tested by experienced personnel, familiar with the practical use to which it may be put, and in this way is often enabled to improve or perfect his apparatus at a comparatively small outlay before placing it on a production basis. In some cases defects are brought to light, which, if not remedied, would have prevented successful marketing. In many cases the manufacturer has inadequate testing



Salt spray and intermittent dipping over considerable periods constitute one of the corrosion tests



This machine is used for testing piston-rod packing



Corrosion fatigue testing machine. The test specimens, A, are rotated at high speed under stress produced by weights and are subjected to a salt water spray

facilities of his own, and to provide special apparatus is often quite expensive.

About five hundred reports of tests are made per annum. Some of these are quite elaborate and have extensive enclosures, drawings, photographs, tables, etc., yet the expense of operating the Station is comparatively small. All told, including the special deposits made by manufacturers and allotments received from all government activities, the sum spent annually is less than a quarter of a million dollars. The field of usefulness of the Station could be increased materially by providing larger appropriations, now only $175,000 a year and by private firms having more testing work authorized.

Authorization and Cost of Tests

The general requirements on which the suitability of material for use on naval vessels is based are set forth, as follows:

(a) Maximum reliability.

(b) Minimum space and weight factors.

(c) Maximum accessibility for inspection, maintenance and repair.

(d) Maximum resistance to corrosive action, in particular that of moist sea air.

(e) Maximum operating and maintenance economy.

(f) Satisfactory operation when permanently inclined up to 15 deg. from the normal horizontal position in any direction; also when used on moving platforms rolling up to 45 deg. from the vertical to either side, dependent on the type of vessel. In this connection it is important that all rotating machinery be installed with the axis of rotation parallel to the keel of the ship.

(g) Satisfactory operation under the large uneven stresses induced by the laboring of a vessel in a seaway and the variable propeller load.

(h) Satisfactory operation under vibrations of the mounting at fairly high frequencies.

(i) Satisfactory operation under very heavy shock to mounting and structure.

(j) Maximum interchangeability of parts.

(k) Minimum number of necessary spare parts together with the best facilities for stowage and handling same when furnished.

(l) Satisfactory identification of all equipment and parts for ease in accurate requisitioning from distant parts of the world.

(m) Satisfactory plans and drawings with full and concise manufacturing and operating instructions.

(n) Readily susceptible to repair by naval personnel, and with the facilities ordinarily to be found on board vessels of the Navy.

The requirements for test are:

(a) That the material or device offered shall have definite application to naval needs.

(b) That it actually has been built and is ready for test.

(c) That the government shall not be involved in any expense whatever either for the cost of the test, the material or apparatus tested, the shipment charges to and from place to test or damage to material or apparatus in consequence of the test.

(d) That the results of the test or the fact that test has been conducted shall not be used for advertising purposes.

Application for test should be made in writing, to the aforementioned Bureau of Engineering, Navy Department, Washington, D. C., and if the nature of the article to be tested is not known or has not been explained in a personal interview, the application must be accompanied by a complete description and blueprints, if necessary, for thorough understanding.

If a test be authorized, the applicant will be put in communication with the Officer-in-Charge, Naval Engineering Experiment Station, Annapolis, Md., or with the commandant of the navy yard concerned,[1] who will furnish information as to any special requirements in connection with the test and will also designate the deposit which it will be necessary to make to cover the probable cost of test. Tests will be undertaken as promptly as practicable after authorization, urgent government tests taking precedence over all others.

When all necessary information has been received by the exhibitor, the material to be tested shall be shipped to one of the following addresses as the case may be, and clearly marked as "Samples for Test":

(a) For the Naval Engineering Experiment Station, address to "Supply Officer, U. S. Naval Academy, Annapolis, Maryland, for Engineering Experiment Station."

(b) For Fuel Oil Test Plant, address to "Supply Officer, Navy Yard, Philadelphia, Pa., for Fuel Oil Test Plant."

(c) For Electrical Laboratory, address to "Supply Officer, Navy Yard, Brooklyqn, N. Y., for Laboratory Officer, Bldg. 22."

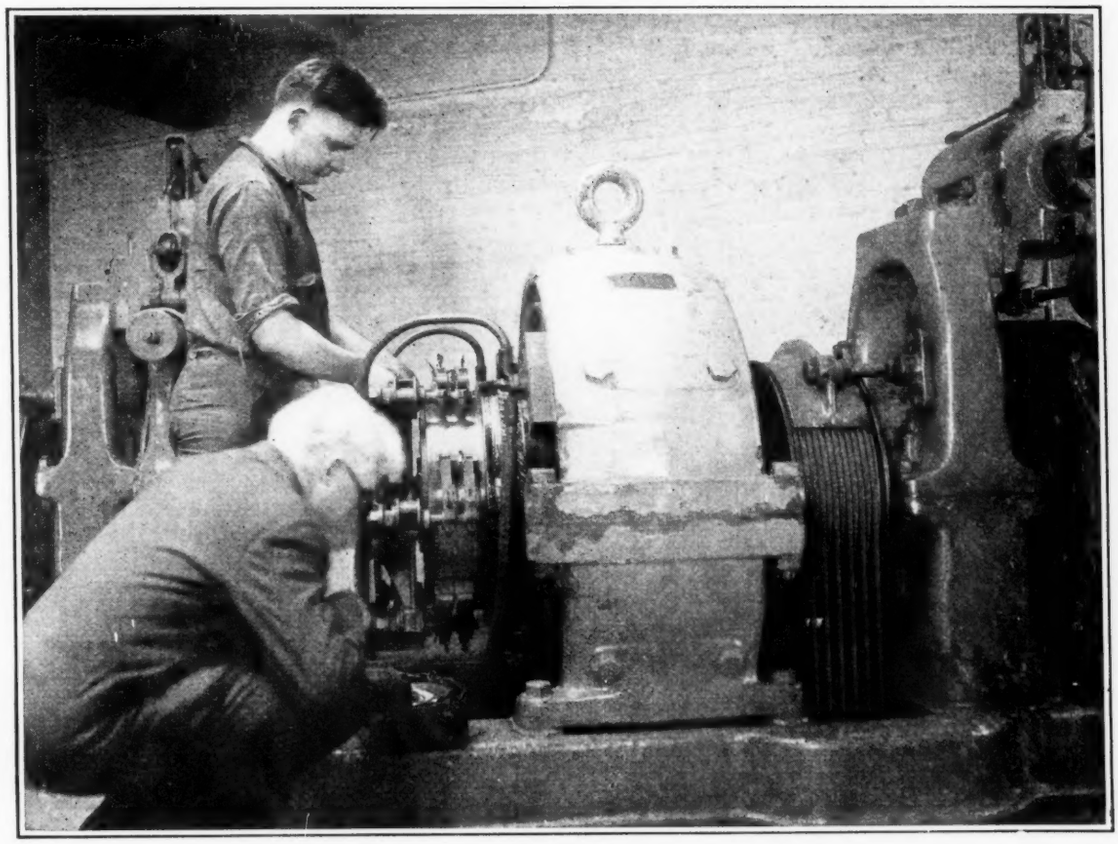
Representative of Applicant May Offer Suggestions

The exhibitor will be allowed to have a representative present during all tests made upon the material submitted by him, and he or his representative may make suggestions or objections concerning the method of carrying out the test; the time for the test shall be set at the convenience of the laboratory concerned, and the exhibitor will be notified if he has previously indicated a desire to have a representative present. Such suggestions will be followed by those conducting the test in so far as practicable and consistent with the purpose to obtain complete and conclusive data. The test authorities will be free to submit the apparatus or material to any test which in their judgment may be desirable to determine its suitability under any special requirements for use in the naval service, whether such tests have been contemplated by the exhibitor or not; except that, in the single case where the exhibitor objects to any proposed test on the ground that he believes the apparatus or material would be injured thereby, and embodies his objection in writing, the particular test will not be made. Any such objection will be made part of the record of the test.

All applicants must agree in writing to accept the conditions of test set forth in this circular, and must further agree in writing that they will accept the results of the test as final and that they will not apply for a retest of the article or material until such changes have been made as will give reasonable promise of overcoming defects which may have developed during the course of the original test.

Upon completion of test a copy of the report thereon will be furnished the exhibitor by the Bureau.

[1] The Bureau of Engineering, Navy Department, has three testing laboratories: The Engineering Experiment Station at Annapolis, the Fuel Oil Test Plant at the Philadelphia Navy Yard, and the Electrical Laboratory at the Brooklyn Navy Yard. The Naval Research Laboratory at Bellevue is administered under the direction of the Technical Aid to the Secretary of the Navy and does special research work not covered by the laboratories under the cognizance of the Bureau of Engineering.



How to locate the

Correct Position of Brushes on Interpole Machines

By C. O. MILLS

BRUSH position on the commutator of the conventional type of direct-current machines, without interpoles, is not fixed and moves with changes in load. With the earlier types of these machines it was necessary to shift the brushes as the load changed, to maintain satisfactory operation at the brushes and commutator. Later types of non-interpole machines have been so designed that satisfactory operation could be obtained throughout their load range with the brushes in a fixed position.

With machines having interpoles of the proper design, the armature neutral and consequently the brush position is fixed. Also, on the interpole machine the neutral is more sharply defined than on the non-interpole type and requires more accurate setting of the brushes. In the factory the correct brush position is generally carefully located and this position marked.

Notwithstanding the brushes on interpole machines are located and marked by the manufacturers, occasion may arise to check their position after the machine goes into operation. There are a number of ways of doing this, some more accurate than others. Before attempting to check the brush position, the mechanical details of the machine should be carefully checked. The brushes should be equally spaced around the commutator, lined up with the segments and properly fitted to the commutator. The brushes should all be of the same grade and equipped with proper shunts for connecting to the brush-holders. A check should be made on the field poles to see that they are symmetrically spaced and that the air gap is uniform around the armature.

An approximate method of locating the neutral, especially on a motor, is to open the shunt-field circuit, as shown at the starting box in Fig. 1, and then place the brushes in a position where the armature does not have a tendency to turn in either direction when the switch is closed and the starting-box arm is placed on the first point. If it is found that the machine has a tendency to turn in one direction, shifting the brushes in the opposite direction should bring them to a position where the armature's torque will be zero. If the motor is of the compound type, it will be necessary also to cut out the series-field winding so that the armature and interpole winding only will be in circuit.

Another method that may be used to obtain an approximate setting of the brushes is to take the speed of the armature in one direction and then reverse the direction of rotation and take the speed again. If the brushes are on the neutral, the speed will be the same in either direction. Shifting the brushes back of the

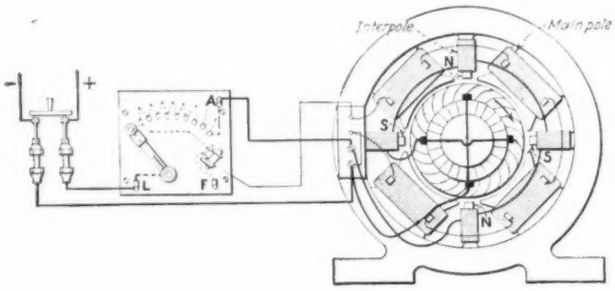


Fig. 1—Shunt-field circuit opened to check position of brushes

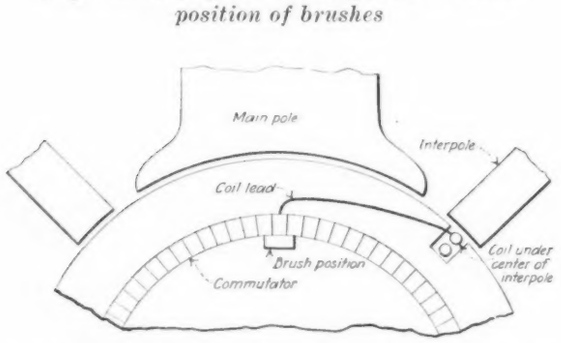


Fig. 2—Shows location of a brush with respect to an armature coil under the center of an interpole

neutral will cause the speed to increase, while a shift ahead of the neutral will reduce the speed below normal. Therefore, if the motor is found to be running fast in the reverse rotation, the brushes should be given a slight forward shift and the speed taken again. When the speed has been reduced about one-half of the original difference between the two directions, the armature rotation can be reversed and the speed checked.

Where the top leads from the armature coils can be followed from the coils in the slots to the commutator, they can be used to obtain the approximate position of the brushes. First move the armature so that an armature slot comes directly under the center of an interpole, as in Fig. 2, then follow the lead from the top side of the coil in this slot to the commutator. The brushes are located so that the segment, to which the coil lead connects, comes under the center of a brush group, as indicated in the figure.

When it can be done, the machine may be operated as a generator without load and its field coils separately excited. With a voltmeter connected to the positive and negative brushes, shift the brushes until a maximum voltage is obtained. On account of the field from the main poles tapering off between the poles, it may be possible to shift the brushes through a considerable arc without affecting the voltmeter reading. The center of this arc is the neutral point. The two extreme positions can be located and marked on the brush yoke and then the brushes shifted to a point midway between these marks.

The most accurate method of locating the brush position is with a millivoltmeter or a voltmeter. To use a millivoltmeter, connect its leads to two segments one pole space apart and, as nearly as can be judged, located in the neutral zone. Then connect the field coils to the line and after a short time open the switch again. This will cause a low voltage to be induced in the armature whose effective value at the neutral is zero. Therefore, the millivoltmeter's reading will be zero if connected to two segments that are in the neutral zone and one pole space apart. This is due to the voltage induced in the armature, by transformer action when the field coils are excited or made dead, being shifted 90 electrical degrees from that obtained by revolving the armature in the field of the polepiece. When the armature is revolved the neutral is between the polepieces and is the point of maximum voltage at no load. When a voltage is induced in the armature winding by making and breaking the field circuit, maximum voltage is obtained when measured at a point under the center of two adjacent poles and zero voltage is obtained at a point between adjacent poles, which is the mechanical neutral of the machine and where the brushes should be located.

One of the objections to the method is that when the field circuit is opened a high voltage is induced in the field coils. This can be eliminated to a certain degree by opening the switch slowly.

It will be found that the neutral shifts slightly for different positions of the armature, which is due to the relative position of the armature slots and the poles. The two extreme neutral positions should be located and the center of the brushes located midway between.

The most accurate way of making this test is to remove the brushes from the holders and substitute a fiber brush in each of two holders one pole space apart.

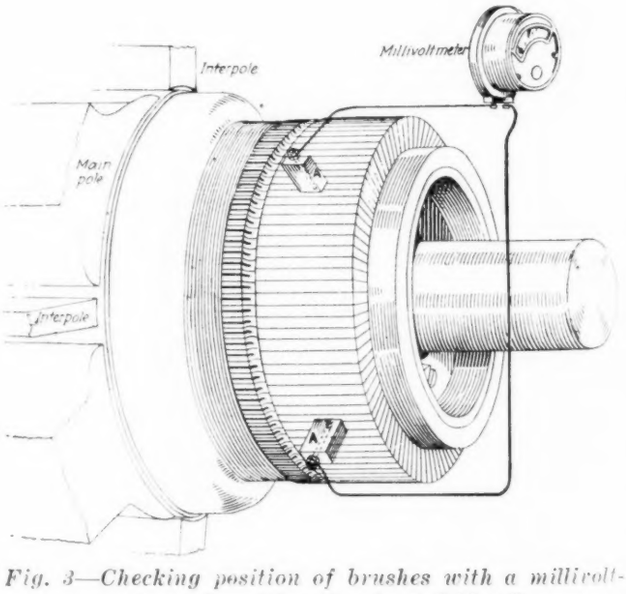


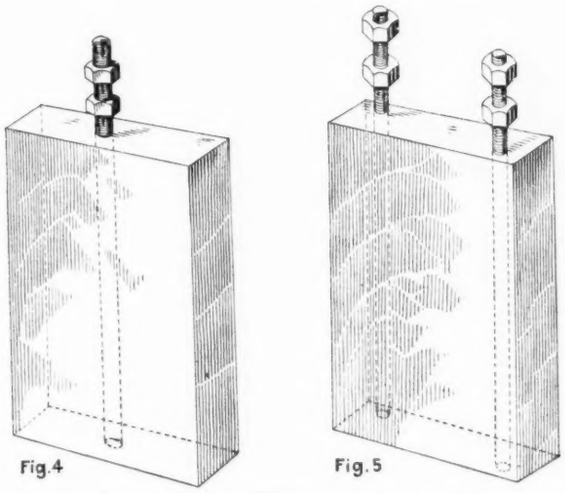
Fig. 3—Checking position of brushes with a millivoltmeter and exciting the shunt-field coils

Through the center of each fiber brush is a brass pin arranged to make contact with the commutator at one end and for attaching the millivoltmeter leads at the other, as indicated in Fig. 3. These brushes may be made for the smallest holders used on a group of motors, and when used in the larger holders, they can be centered with wedges or strips of thin fiber. The use of the fiber test brushes insures that the brushes will be set in the exact location determined by the millivoltmeter. Since the voltmeter leads are connected to the

test brushes, the one making the test is free to attend to the other details of the test. An enlarged drawing of one of the brushes is shown in Fig. 4.

A method that is in common use and one that gives the most satisfactory results is to take the voltage drop between segments in the neutral zone with a millivoltmeter when the machine is in operation. One of the best ways of doing this is to drive the machine as a generator and then, with two contacts spaced about the width of one segment apart, explore near the neutral zone until a position is found where zero reading is obtained on the millivoltmeter, which position will be the neutral point.

A set of leads for making this test is shown in Fig. 6. These testing leads are made by using two pieces of No. 14 rubber-covered wire about six inches long to which are soldered the flexible leads for connecting to the millivoltmeter. After this is done, the two contact wires are taped together for convenient use. The distance between the contact ends of the leads can be



Figs. 4 and 5—Fiber brushes used to check brush position

adjusted by bending if necessary. How the test leads and millivoltmeter are used is indicated in Fig. 7.

Instead of using contacts of the type shown in Fig. 7, a fiber brush arranged with two small brass contacts spaced so that they will rest on adjacent segments, simplifies making the test. This brush, Fig. 5, is put into one of the holders, the millivoltmeter connected to the top ends of the contacts and everything is ready to make the test.

After the no-load neutral position of the brushes has been located on the commutator of an interpole machine, replace the brushes and put full load on the machine and again test with the millivoltmeter for the neutral position. Zero reading should be obtained in the same location on the commutator at full load as at no load if the interpoles are of the correct strength.

Where the neutral is located with the brushes in the holders, due to the presence of circulating currents in the brush faces, the neutral may shift slightly when the brushes are moved through a small arc around the commutator. A little experimenting will locate a position where the neutral will remain stationary irrespective of the brush position, if the load is held constant.

If, on a motor, the load neutral shifts ahead of the no-load neutral and on a generator behind the no-load neutral, the interpoles are too strong. On the other hand, if the load neutral shifts behind the no-load neutral on a motor and ahead on a generator, then the interpoles are weak.

When the interpoles are too strong, it may be possible to adjust them by removing shims from between the

Fig. 6—Test leads for use with millivoltmeter when checking the brush position

polepieces and the frame, which will result in increasing the air gap between the pole faces and the armature. Where a shunt has been used by the manufacturer to adjust the current through the interpole winding, increasing the cross-section of this shunt will reduce the current through the interpole coils and the strength of these poles. If the shunt is not already on the machine, one may be made from a german silver strip of proper length and cross-section, which will have to be determined by experiment. On small and medium-sized machines turns may be removed from the interpole coils.

To increase the strength of the interpoles, it may be possible to add soft-iron or soft-steel shims between

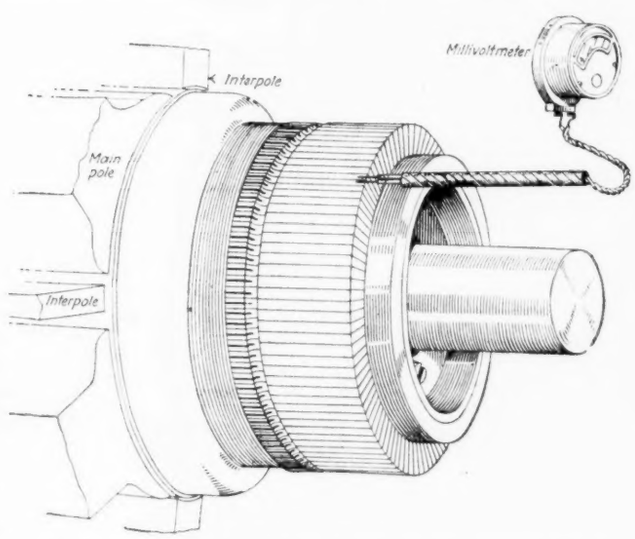


Fig. 7—Locating neutral point on the commutator with a millivoltmeter

these polepieces and the frame to decrease the air gap at the armature. If this cannot be done, increasing the number of turns in the coils may have the desired effect, or it may be that a combination of the two methods can be used. When a shunt is connected across the interpole-winding terminals, decreasing the cross-section of this shunt will increase the current through the coils and increase the field strength. All these cures have to be applied by the cut-and-try method, but a little careful experimenting should be productive of results.

Is the Permanent-Gas Engine a Possibility?

BY JOHN STURGESS

NOT all engineering achievements are the result of sudden inspiration and creative ability. Some follow the slower path of evolution, being gradually whipped into practical shape by successive attacks between lapses of inattention. This generality applies to the permanent-gas engine, so called because its working medium is a permanent gas, and not steam as with the steam engine, or combustible gases as with the internal-combustion engine. This term is used to distinguish it from its old prototype the hot-air engine, for the double reason that it differs in many essential particulars and to avoid hasty judgments based on incorrect association with the older machine.

The author does not pretend that all technical problems have been fully solved. He has been prompted to outline the proposed system by the reflection that great strides have been made in machine design and resources in materials of construction since the last attacks were made many years ago. Space limitations permit only briefly touching on some of the salient points, which have been much more exhaustively developed in an original treatise of which this article is an abridgement, and the unsupported character of some of the statements made must be attributed to this fact.

THE old-time hot-air engine failed because of its low temperature range. By increasing the maximum temperatures to 1,100 degrees a net efficiency of 24 per cent is claimed. Pressures are low when compared to other modern machines of equal efficiency.

The suggested engine is shown in the illustration. The notations make the functions of the various elements clear, the arrows showing the course of the working agent. The working cylinder draws in a supply of hot gas until cutoff takes place at one-half stroke. The exhaust valve opens at the end of the stroke and the gas charge is exhausted, during the next stroke, into the economizer, where it first heats the furnace air to 560 deg. F. and then passes to the low-temperature heat transfer, where cooling water reduces its temperature to 100 deg. F.

It is then drawn into the recompressor and compressed to 200 lb. and after passing into the high temperature transfer, is heated to 1,020 deg. F., whereupon it is ready to repeat the cycle.

The study has been based on the values of 1 cu.ft. of working agent at 200 lb. gage pressure in the high-pressure receiver. The assumed temperature range was from the available cooling water at 60 deg. to an assumed maximum practical temperature of approximately 1,000 deg. F., and to simplify the calculations this was set at 1,020 deg.

The work done during the cycle has been carefully calculated and checked by two methods—one by the pressure-volume method based on the usual formula for adiabatic expansion, and the other the B.t.u. method based on the work-equivalent of the heat conversion. The results compare as follows:

Net Work, as calculated on a PV. basis,
ft.-lb. per cu.ft. 25,050

Net Work, as calculated on a B.t.u. per
ft.-lb. per cu.ft. 26,000

Complete efficiency calculations are too elaborate to present here in detail. They embrace the efficiency of combustion, efficiency of heat transfers as well as the efficiencies of the engine and the recompressor. They include the loss from dilution of combustion products, flue-gas loss, cooling-water loss, and loss in mechanical friction. The only losses not considered are radiation, leakage and the internal friction of the working agent. These are indeterminate, but by careful design may be reduced to a sufficiently low figure to still leave the net efficiency favorably comparable with other prime movers in the field to which this engine would be applicable. The over-all thermal efficiency as thus calculated is 22 per cent at full load, a figure that is excelled only by the Diesel engine and equaled only by the very largest steam-turbine plants provided with every known appliance contributing to economy.

One can only make broad deductions based on certain fundamental factors, concerning the question of cost. This method, moreover, is likely to prove more accurate than detailed estimates. It relies on making comparisons of groups of parts of unknown cost with analagous groups of parts of known cost, and then applying such corrections as seem logical for such differences as may exist between the two groups.

In an engine for given piston speeds, the horsepower is a function of the mean effective pressure per revolution; that is, the m.e.p. of the working stroke divided by the number of revolutions required for each complete cycle. In the proposed engine there are two working strokes per revolution, or 0.5 revolution per working stroke, and the m.e.p. works out as 42 lb. net, making the m.e.p. per revolution 84 lb.

In a four-stroke-cycle internal-combustion engine the m.e.p. is around 70 lb. There are two revolutions per cycle, so the m.e.p. per revolution is 35 lb. The proposed engine therefore starts off with an advantage of 2.4 to 1 with respect to piston displacement, as compared to the internal-combustion engine.

The strength and weight of an engine are governed largely by the maximum stresses they have to with-

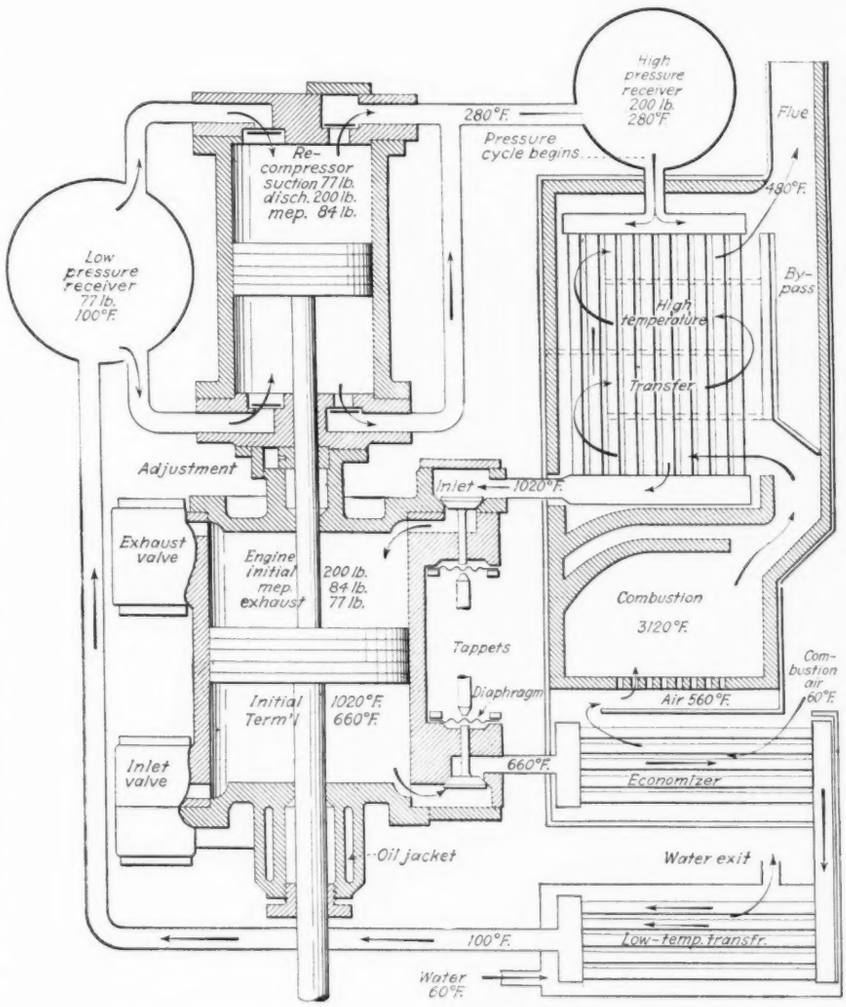
stand, not the average stresses. In the Diesel engine the maximum stresses are those due to a piston load of around 500 lb. per sq.in.; consequently, every part of the engine has to be made of sufficient strength and weight to withstand this load.

In the proposed engine the maximum piston load is that due to 200 lb. per sq.in. Since for given horsepower and piston speed the piston area need only be $\frac{1}{2.4}$ of the Diesel, its lead over this competitor is increased by taking the product of the above ratios, that is, 2.5×2.4 or 6 to 1 in respect to total weight of the engine proper. Costs depend on the weight and quality of the material and workmanship required. The latter are not likely to be so exacting for a 200-lb. maximum pressure as for a 500-lb. pressure, but no advantage will be claimed for this indeterminate amount. The foregoing ratio of 6 to 1 lead over the four-stroke-cycle Diesel is not materially changed if a two-stroke cycle is considered, for the m.e.p. of some engines of this type is around 40 lb., and having one cycle per revolution the m.e.p. per rev. is 40, compared to 35 for the four-stroke cycle. The foregoing concerns the engine proper, not the auxiliary apparatus. The latter can reasonably be considered in their cost relation with the engine proper. The auxiliary apparatus in the permanent-gas engine are the recompressor, the receivers, the heat transfers as well as the furnace and piping. The auxiliary apparatus of the Diesel engine are the injection-air compressor, the fuel pumps, air bottles and starting set, and piping.

The recompressor, being tandem connected, is little more than a cylinder and piston. Its apparent ratio to the rest of the engine proper is about 1 to 7. The receivers and piping can reasonably be set as equal to the recompressor, making the ratio of both these groups to the engine proper as 1 to 3.5. This reduces the lead of the new engine, for the parts thus far considered to 4.45 to 1.

The auxiliary apparatus of the Diesel will easily account for 20 per cent of its total cost, so that the inclusion of these items will again change the lead of the permanent-gas engine to 5.35 to 1 for the parts considered.

The parts considered now include all the Diesel, but only the engine, recompressor, receiver and piping of the permanent-gas engine; that is, they do not include the entire group of parts comprising the heat interchangers. The reasoning is purposely pursued in this way because the cost of this group cannot be determined by the process given, but it does lead to definite conclusion. We can afford to spend over five times the cost of the engine, compressor, receivers and piping, on the interchangers, and then be substantially neck-and-neck with the cost of the Diesel engine. Since ordinary materials and welded construction will suffice for the economizer and low-temperature interchanger, and the high-temperature transfer is the only element requiring special materials and construction, it means that most of the sum mentioned is available for this special construction. Diesel engines sell at around $75 per horsepower. Segregating this in the ratios cited results in $14 per horsepower for the permanent-gas engine exclusive of interchangers, and $61 per horsepower for the latter. Steam turbines with boilers and auxiliaries cost considerably less than equivalent Diesel engines, so that in this case the amount available for interchangers would be correspondingly reduced.



Diagrammatic outline of suggested permanent-gas engine

Corrosion of metal heater tubes under high temperatures is due largely, if not entirely, to the presence of oxygen and sulphur compounds. It is proposed to eliminate these on the inside walls of the tubes by using an inert gas for the working agent, probably nitrogen. This is believed to be practical in view of the fact that the working agent is confined and not lost, and only slight leakage would need to be made up.

To avoid the corrosion of the outside walls due to their exposure to the residual oxygen and the sulphur

of the flue gases at high temperature, if our present resources in non-corrosive alloys fail, it is believed that any one of a variety of methods of shielding the walls from contact with the gases, without interfering with heat-conduction, may be a practical method of solving this problem.

The second problem is that of cylinder-wall lubrication at an average temperature of probably 800 deg. F. This is somewhat beyond our present resources with liquid lubricants, but there remains the adaption of graphitic, or similar lubricants which may be feasible. If, however, this fails, a novel but entirely practical design of cylinder and piston is proposed in which the lubricated zone is sufficiently removed and insulated from the heated zone, and thus reduces the temperature of the former well within proved practicable limits.

The inlet valve would be exposed to a temperature of about 1,000 deg. F., but this is probably well below that of airplane-engine exhaust valves, and moreover, the inlet valve would be of much sturdier proportions, aiding heat conduction and lessening distortion.

A similar line of reasoning to that used when discussing cost shows that it could compete on the scarcely less important points of floor space, cubic space and tonnage. There remains open only the question of maintenance, and this concerns only the high-temperature transfer, since all other parts of the unit are operating under comparatively low temperatures and low stresses without shocks.

Since it is not limited to the use of liquid fuel, it may be a logical candidate for locations where other fuel is available and the internal-combustion engine has been ruled out on this account. Its efficiency in the smaller sizes might easily excel that of the steam plant, while its smaller space and weight may give it a further advantage.

It would be applicable to plants of fairly large capacity for stand-by service in public utility systems, peak-load service, or temporary supply at the extremities of transmission lines. Its ability to go into service quickly from a cold start would give it an advantage over the steam plant in this respect.

The whole power field is a large one, and the qualities demanded of prime movers in different sections of that field are extremely diversified. No one prime mover meets the entire range of demands. The excuse for this discussion is the belief that if the permanent-gas engine were reclaimed from its present ostracized position and its problems as courageously attacked as other engineering problems have been, another useful member might be added to the family of prime movers.

A SUBSTANTIAL GAIN IN ECONOMY may be obtained in existing plants by increasing the superheat. An increase in superheat of 10 or 12 deg. F. will result in an increase in plant over-all economy of approximately 0.5 per cent. There are a number of methods that may be employed to obtain this increase, among which are: installing radiant superheaters, removing boiler tubes below the superheater, changing the boiler baffling, and covering steam circulation tubes. In new installations trouble is sometimes experienced from superheats too high for the equipment. The converse of the foregoing methods may likewise be used to reduce superheat. In reducing superheating surface it should be realized that an increased pressure drop through the superheater will result because of increased steam velocities.

What Do You Know?

UNLIKE the questions appearing in the daily papers, the "What Do You Know" questions in *Power* are of real value. It is not of importance if one can or cannot tell the founder of the Ming dynasty of China in the Tenth Century, but if an engineer finds he is hazy on a question of pump-valve setting or the like, it is fair warning that he should burn a little midnight oil. Correct answers are to be found on page 998.

Ques. 1—What is meant by the critical speed of a turbine?

Ques. 2—When was pulverized coal first suggested as a boiler fuel?

Ques. 3—In keying up a connecting rod having straps, gibs and keys, what should be the position of the crank relative to the cylinder line of center?

Ques. 4—If one field coil of a two-pole direct-current motor burned out, what would be the most likely cause of the trouble?

Ques. 5—What kind of valves did the Porter-Allen engine have?

Ques. 6—What special features have a department-store type elevator control system?

Ques. 7—Does the crosshead and piston stop when the end of the stroke is reached, and as the crank passes dead center?

Ques. 8—What is the percentage of slip of a 15x8x 10-in. double-acting steam pump making 50 strokes per minute?

Ques. 9—Will the oil particles issuing from a Diesel fuel valve using air for the injecting medium travel a greater distance than the oil from the solid-injection nozzle?

Ques. 10—When ammonia emerges from the low-pressure side of an expansion valve, is it a gas or a liquid?

The most effective condenser for a given duty is not necessarily the one having the most surface, but rather the one in which the proper amount of surface is arranged so that all of it is accessible to the steam. Moreover, a reduction in the amount of surface does not imply a reduction in the size of the condenser shell, the difference lying in the increased tube spacing or in lanes between the tube banks.

The Mortality Rate of Air Tanks

By B. J. Parker

AT ONE time air compressors and receivers were few and far between. Even a high percentage of receiver explosions meant only a small number. In addition the equipment was in charge of engineers who knew how to prevent ruptures. Now that the automobile has become the chief agency of getting from here to there, things have changed.

All the air going into the 80 million tires has been stored for the most part in tanks of less than 18-in. diameter. There are tanks of all shapes and sizes, but generally 4 or 5 ft. long and 12 to 16 in. diameter, located in garages, shops, service stations, stores, under work benches, on the walls and on top of offices, in fact in every nook and cranny where they will be out of sight and consequently out of mind. Most always the tank is in a place where someone gets hurt or killed when it goes off, and 99.75 per cent of these tanks have no handholes or inspection holes large enough to see the internal condition of the shells.

The A.S.M.E. Code for unfired pressure vessels, specifies that all such vessels less than 16 in. in diameter may be constructed without a handhole provided there are at least two pipe connections or provided they have bolted blank flange heads. What good the pipe connection does is unknown. What can one see through a ¾-in. pipe opening in the shell of a 14-in. tank?

Anyway, we have thousands of such tanks in this country under 16-in. diameter with welded-in heads and no inspection or even peep holes.

For safety's sake, if we are going to try to forget

Fig. 1—The air tank usually is under a work bench or some out-of-the-way place

them, let us bury them deep enough so that when they burst no one will be injured. None of us minds being killed dead, but no one fancies the idea of being a cripple the rest of his life.

The most of air-tank failures I have come across are of tanks not constructed in accordance with the Code, and fail in defective welding of the longitudinal seams or the heads. But remember we have few old air tanks of this size. These little life takers have sprung up like a crop of mushrooms in the last five or six years, for we must roll on air these days. And believe it or not, they are rusting and corroding on the inside. How rapid this corrosion is, no one can definitely state, and its progress will vary with the individual tank. What we must have is one or two handholes in them regardless of size, so we can put in a light and see how far the corrosion has gone.

The other day I saw the concave head of a 7-in. tank that had blown off and killed one man. Not long ago I was in a garage where the air compressor rested on a wall shelf. I said to the owner, "Why haven't you a drain pipe and valve on that tank?"

There never had been one on the tank, so he stated. He further volunteered that a week or so previous, they could not get enough air out of the tank to fill a tire.

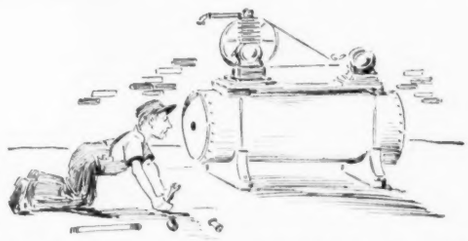


Fig. 2—What can one see through a pipe opening?

Investigation revealed the tank full of oil and water; this had accumulated in the five years the outfit had been in use.

He then remarked that when they were draining the tank of the oil and water, the hole kept getting clogged with rust and rust scale. It does not take much imagination to caliper the thickness of the shell, when by the hammering they could dislodge enough scale from the walls to clog the hole again and again.

One does not have to be told that this case is not exceptional. Everyone will admit that there are probably many others.

Remember, age does the trick to us all, and these tanks are going to age fast, for they start off with an acid stomach in their first month. They are still young, maybe having an average age of five years. Those that I have been able to examine show marked progress in pitting and corrosion. What are we to do? Put handholes in them? Classify them as explosives, and organize a strict inspection on the little fellows as well as the big ones?

Most of the men around these tanks do not know they are dynamite, and rather think I am kidding them when I tell them the little brass appendix called the safety valve may save a life some day if they keep paint off of it and learn how to test it for free operation daily.

The most recent compressor units have only enough storage to control the automatic pressure switch, and these are the safe goods. More power to them, but while we have the little tanks in our midst, we must watch them, both outside and inside.

There Is for All Oils a certain temperature, depending upon the oil's viscosity and gravity, at which the viscosity is so reduced that a maximum amount may be atomized. Too high a temperature causes pulsations in the flame and too low a temperature will cause smoke, poor combustion and burning in the uptake of the boiler. Just what this temperature is for a particular oil can be determined only by observation of the burner action.

No, this is not a magician, but Judge Gary starting one of the largest steel-mill power plants

Wave of the Hand
Starts Steel-Mill Power Plant 400 Miles Away

THE new Homestead mills of the Carnegie Steel Co., near Pittsburgh, Pa., exemplify the latest in steel-mill practice and the application of power to this industry. In these mills there are 836 motors, having an aggregate rating of 100,000 hp., to which must be added 65,000 hp. of motors and generators used with main-roll drive reversing motors, making a total of 165,000 hp. These motors are supplied from a 45,800-kw. steam-turbine generating plant. The largest motors in the mill are of the direct-current type, rated at 8,000 hp. when operating at 40 to 80 r.p.m.

On Thursday, June 16, while about 1,000 members of the Association of Iron and Steel Electrical Engineers and their friends were visiting these mills, Judge Gary, Chairman of the Board of Directors of the United Steel Corporation, in his New York office started a 6,000-kw. motor-generator set, Fig. 1, for supplying power to one of the 8,000-hp. reversing-mill motors. To start the motor-generator set, Judge Gary simply passed his hand over a crystal sphere on his desk, as indicated in the headpiece. This sphere is of hollow glass silvered on the inside. A fine wire ran from the silver lining to the grid of the Knowles grid-glow relay tube mounted on a small box in which is the relay.

When Judge Gary's hand was placed within an inch of the sphere, electrons were removed from the grid of the tube which allowed a current to flow to operate the relay. This relay closed a circuit through a telegraph line to the keying relay in the short-wire radio station WAQ, located on the roof of the Newark works of the Westinghouse Electric & Manufacturing Co. These signals were sent by short radio waves to the Homewood receiving station near Pittsburgh and by telephone line to the Homestead works of the steel company, where they were translated by a vacuum-tube relay and call selector to give the initial impulse to the automatic-starting equipment of the motor-generator set.

The demonstration was arranged by the Steel Corporation and the Westinghouse Electric & Manufacturing Co. as a feature of the Association of Iron and Steel Electrical Engineers convention then in progress. The demonstration was a revelation of what engineers can do with very small electric currents in controlling large power machinery.

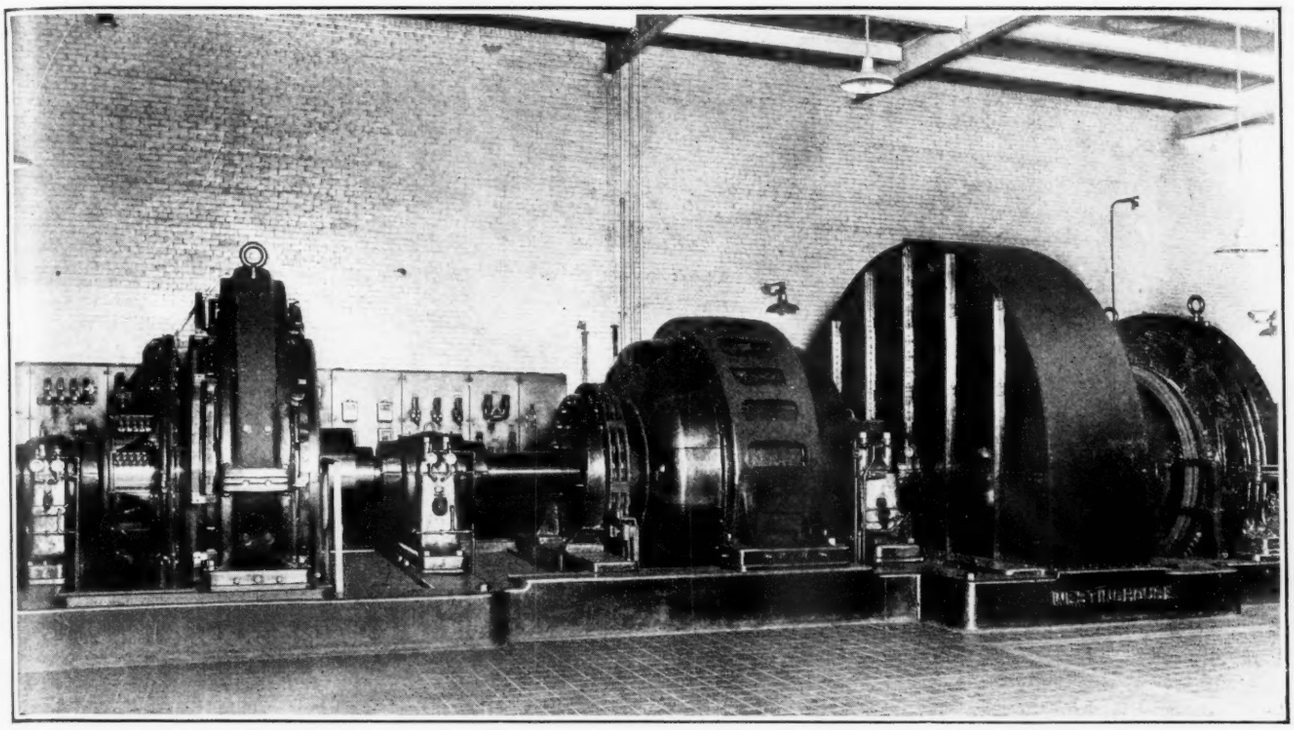
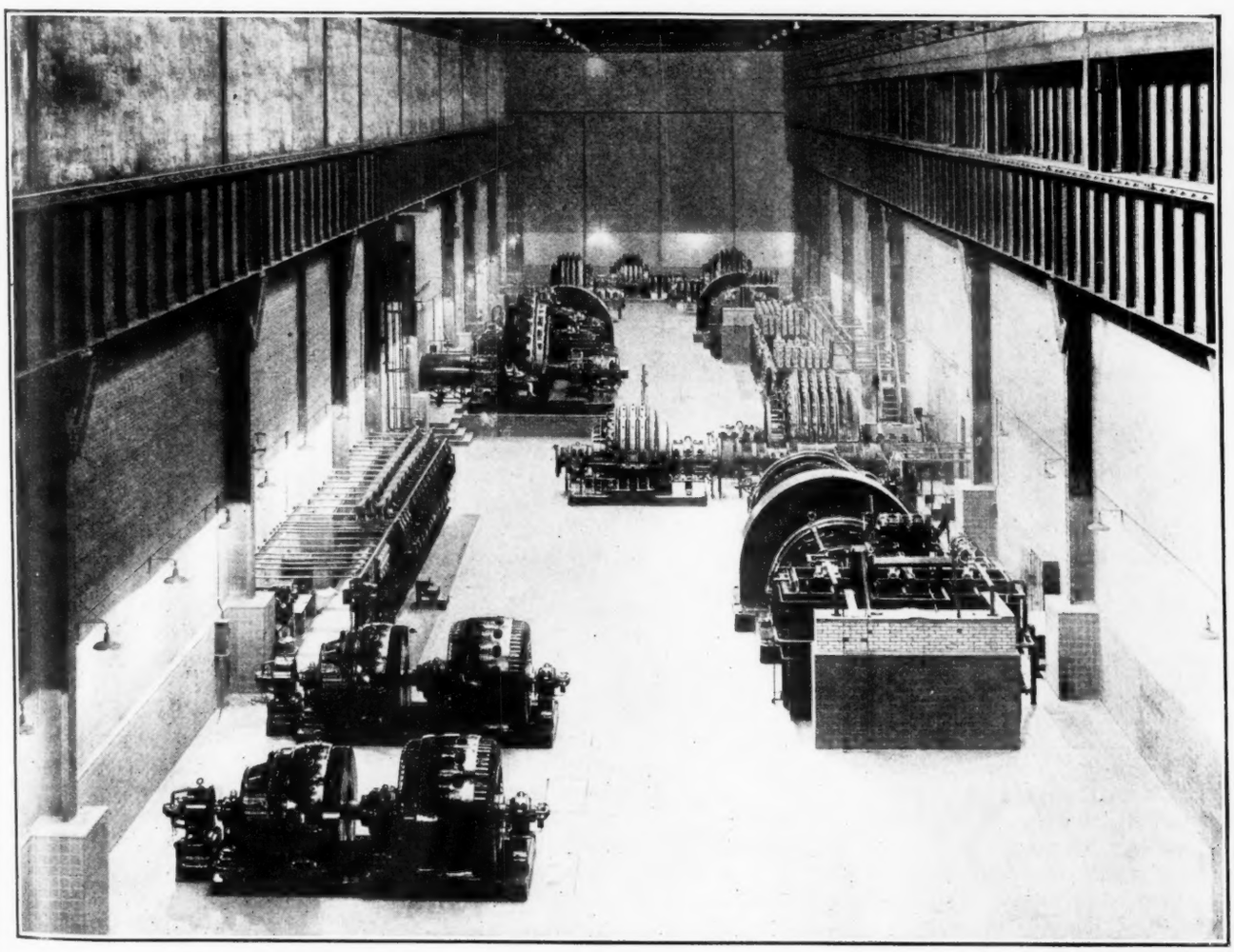


Fig. 1 (Above)—Motor-generator set consists of a 7,000-hp. a.-c. motor, two 3,000-kw. d.-c. generators and a 50-ton flywheel

Fig. 2 (Below)—Finishing-mill motor room contains 53,000-hp. capacity in motors and 18,000-kw. of generator capacity



Breaking in a New Fireman

A Few Pointers on Training a New Man—How To Explain Boiler Economy Without a Lot of Mathematics—Factors That Make Firing a Hard or an Easy Task

By PETER J. LYONS

IF AN engineer hopes to obtain even a fair degree of boiler-room efficiency, he must begin educating the fireman when the latter first appears on the job. If started right, the newcomer will develop into a real dependable fireman, but if he receives no instruction at the start, it is difficult to correct faulty methods later.

In his progressive education he will need some simple apparatus to enable him to observe the results obtained from a given course of action. I suggest an Orsat instrument to check the CO_2 content of the flue gas and to permit him to find how the CO_2 varies with the firing conditions. A draft gage is another instrument the boiler room should have. Explain its action and let him find out for himself how the reading changes with

Fig. 1—Show the fireman how to use an Orsat

changes in the damper setting, condition of the fire bed, etc.

The draft gage will indicate the condition of the fuel bed. If the fuel is too thick upon the grates or the fires are getting dirty, the gage will indicate an increase in the draft. If the fires are too thin and if holes and cracks form in the fuel bed, a decrease in draft will be indicated on the gage. The cost of a draft gage is so insignificant that no plant should be without one.

Show him that draft is a push and not a pull. The cold air rushes from below and pushes the hot air up the chimney in an effort to establish equilibrium between the inside and the outside of a chimney. If the draft is poor, it can be improved by insulating the breeching, as leakage around the uptake impairs the draft; air leakage into the breeching, however, will not lower the boiler efficiency in ordinary circumstances, and under certain conditions it might improve efficiency by cutting down the draft, as the tendency in most boiler plants is to use too much draft.

The engineer should emphasize the waste occasioned

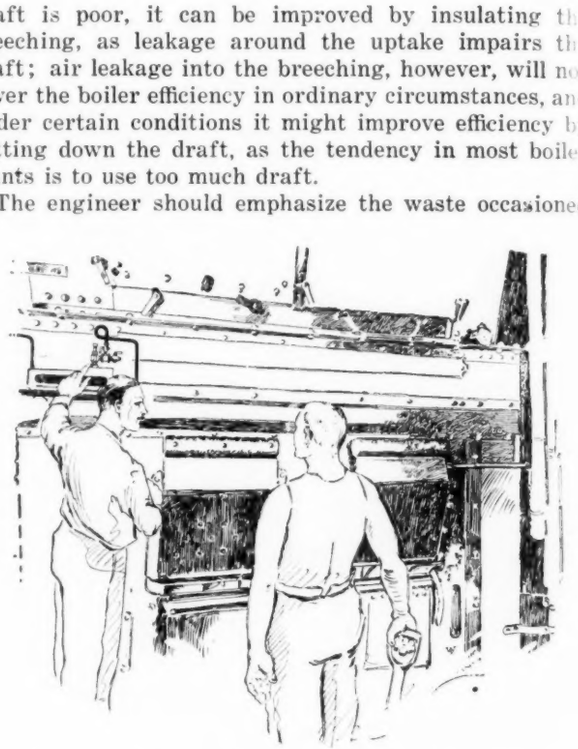


Fig. 2—Outline the purpose of the draft gage

by excess air, whether due to too much draft, a crack in the boiler setting, holes in the fuel bed or leaks around clean-out doors. It is of importance to stop all air leaks, and a coat of a good plastic substance all over the brickwork makes a good overcoat, as it were, to keep the heat in and the cold air out. Show the fireman that he should not consider the boiler and the furnace as a unit. Point out that the furnace is a heat generator and the boiler a heat absorber. To make the furnace an efficient heat generator, it is necessary to exclude excess air, which lowers the furnace temperature, reduces the CO_2 content and impairs the general efficiency of the furnace. For the boiler to be an efficient heat absorber, it is necessary to keep it as free from soot as possible, for soot is a better non-conductor of heat than asbestos.

If the setting is low, the gases coming in contact with the cold surface of the boiler before proper ignition takes place, are chilled and proper combustion is not performed. For proper combustion there must be time and volume, and for a high combined efficiency one must have a tight boiler setting and clean internal and external boiler surfaces.

If a boiler is to be laid up for an extended period,

it should first be boiled out with soda ash, drained and washed out with a high-pressure hose to remove the mud balls commonly called barnacles. If they are not removed and are left on the tubes, every boiler inspector knows that pitting will start under the barnacles and will continue until the pit extends through the tube, making a tube renewal necessary.

It is largely a matter of opinion as to whether water should be left in while the boiler is laid up. It must be remembered that rust is always associated with water and oxygen. If the water is left in—that is, if the boiler is refilled after being thoroughly washed out—it should be filled completely to the safety valve. Even this does not exclude all the air, for there is a considerable amount in the water. If left dry, a tray of hot charcoal should be put in the bottom manhole to assist in the drying out process. After being dried as thoroughly as possible, a box of lime should be set in, to absorb any moisture in the air, and the manhole covers put on.

One of the chief causes of boiler maintenance is excess scale, causing the sheet to bag. Impress on the fireman that frequent tube renewals are necessary when the scale accumulates on the rear head between the tubes. But even more disastrous bagging is occasioned by oil lodging on shell plates, as oil and water will not mix; that is, oil on the shell plates repels the water, the plate gets overheated, and pressure within exerted on the hot plate soon produces a bulge.

The engineer should leave such information with the fireman, feeding him bit by bit as his ability to absorb knowledge may permit.

What Would You Do?

When a wise man gives thee better counsel, give me mine again. I would have none but knaves follow it, since a fool gives it.—*King Lear (Act II, Sc. IV).*

"What would you do if you were in my place? If we make changes in our plant that would save the owners around nine or ten thousand dollars annually, they will have no further need of my services and I will be out in the cold."

"Hold on a minute, Bill, not so fast. I have an idea of what you are driving at, but let's have the whole story from the beginning. What are the changes you refer to that will involve such a large saving to the firm, and why should these improvements affect you adversely?" Bill reflected for a moment, lit his pipe, and began:

"The plant has seen a good many changes since I came here twenty years ago. At that time we did not use as many kilowatt-hours in producing the various articles that are made here. Only in the last few years has automatic machinery replaced hand operation in our business. The point I want to make right now is that the cost department figures the power expense as 10 per cent of the cost of production, where fifteen years ago it was only 2 per cent of the finished article. Besides the increased use of electric power, there is another reason for the jump in power costs. Twenty years ago coal was cheap and the boilers and engines were in good shape. Today, with the high cost of fuel and worn-out boiler settings, not to mention obsolete and overloaded generating units, our own power-plant operating expense per pound of steam and per kilowatt-hour has steadily increased.

"For several years the electric light company has beaten us in the matter of costs of electric power, while ours are still going up. At that time the utility people wanted to take us on, but I pointed out that we would still have to keep the boiler plant to supply process steam. Figuring the cost of utility power and operation of the boiler house just for steam made their proposition unfavorable.

"A few weeks ago our next door neighbor, who uses a good deal more power than we do, offered to sell us exhaust steam from his more modern plant at a very attractive figure. He could well afford to do this because the steam would be exhausted from his engines to the roof for about ten months of the year. The owners of our plant after a casual consideration turned the proposition over to me for recommendation. The saving I referred to is obtained by a combination of central-station electrical energy and low-pressure steam from next door for heating and process work.

"Now you know that the business changed hands after the old man died and the new owners are notoriously tight. If I give them the results of my careful observations, they will go over to the proposed plan. From then on, the position of chief engineer will cease to be. In other words, I will be through."

After several minutes of reflection I broke the silence with:

"Are you sure, Bill, that the owners would let you down after increasing their earnings by such a large amount each year through operation on the proposed plan?"

"You misunderstand me there," Bill replied. "They would give me a chance to work in production, but I would have to learn a new trade and the necessary change in salary that must accompany such a move puts that out of the question."

"How about the job of master mechanic?" I asked, still trying to feel optimistic about it all.

"Yes, I have thought of that too, but that individual is still in good health and has every prospect of remaining in his present position."

Still hopeful, I countered with this:

"Why not induce the owners to rebuild the power plant; with modern equipment you could match central-station service?"

"You are wrong again," was Bill's reply. "I have figured that the increasingly larger amount of electrical energy used with no possibility of operating our plant condensing makes the project of revamping for investment a poor proposition when compared to the new plan."

For a while we smoked in silence, then Bill suggested,

"Why not write to *Power* and perhaps we can learn what other engineers would do in a situation of this kind."

What would *you* do?

IF CORROSION OF A BOILER is at or above the water line, it is likely that the water is highly aërated. Corrosion below the water line usually is due to the presence of an acid in the water. A small quantity of soda ash in the feed water may be beneficial. Another method of arresting corrosion below the water line would be to place only enough lime in the boilers to form a whitewash coating so thin that it would not endanger burning them or materially affect the economy of the boilers and coat the surfaces above the water line with a thin lime wash.

Testing High-Pressure Boiler Drums in Germany

By James Silberstein

The marked tendency during recent years toward the employment of very high pressures in steam boilers has called for the introduction of special manufacturing and testing methods to produce and test the drums that have to withstand these pressures. The firm of Messrs. Thyssen & Co., Muhlheim-Ruhr, Germany, has developed a process of making welded drums for working pressures of 800 to 1,500 lb. per sq.in. At first thought many engineers might be inclined to distrust a drum made of metal perhaps 3½-in. thick with a weld running the full length of the body. It is certain, however, that with the precautions taken in manufacture and in the subsequent processes of annealing and testing, the result is as good as could be desired. Ample experience has now been gained to justify the method and to demonstrate the reliability of the welded drums.

How the Testing Is Done

In the system of testing the drums are subjected to a hydraulic pressure that stresses the metal almost to its limit of elasticity. For the test the drum is whitewashed all over, the manhole covers are put on, and the drum is mounted on anti-friction rollers conveniently for observation. At intervals of a few feet along its length, thin steel measuring tapes are wound around it. Each tape makes rather more than a complete turn; one end is fixed to a support independent of the drum, and the other is weighted, so that the tape, though under the tension of the weight, is free to accommodate itself to the expansion of the drum. The amount of the circumferential expansion for any given internal pressure can be easily read at the point where the tape passes itself on the drum. In addition to the tapes, a large number of indicating pointers, mounted in holders in which they can slide with a little friction, are arranged normally to the boiler drum, so as to indicate the expansion of parts selected for observation. A record of the strains caused by the internal pressure is thus obtained, and the stresses, predicted by calculation, can be checked. The hydraulic pressure available permits of drums being tested up to an internal pressure of 350 atmospheres, or approximately 5,000 lb. per sq.in.

By stressing the drums up to the elastic limit certain structural changes are produced in the material, which it is desirable to eliminate. With this object in view the drums are placed in an annealing furnace and the metal restored to its original ductile condition. The final result is a drum of which the soundness has been demonstrated by the severest test that could be carried out short of destruction, free from any strain or local hardness. It should be noted that by stressing the drum to the elastic limit by internal pressure, its circularity is insured, so that no subsequently applied pressure can set up secondary stresses owing to deformation.

To assure themselves that annealing really did restore the strained metal, as well as to satisfy themselves that a properly made weld was in every respect as sound as the solid plate, Messrs. Thyssen carried out an elaborate series of experiments upon a full-sized drum 45 in. in diameter, made of plates 1$\frac{31}{32}$-in. thick. After annealing, the drum was cut up and scores of test pieces were taken, longitudinally, circumferentially and radially, and from various depths in the plate. As might be expected, special care was taken to have a large number of the test pieces cut from metal containing the weld.

It would take up far too much space to describe in detail the results obtained. It is sufficient to say that, so far as tensile tests were concerned, there was no appreciable difference between test pieces taken from the weld and those taken from the solid metal. Impact tests on pieces taken from the welded zone showed indeed a somewhat higher resistance than others to fracture. This is possibly explicable by the intensive working which the metal had had in the neighborhood of the weld, but in any case the difference was so slight that for all practical purposes the drum can be assumed to consist of homogeneous metal.

Answers To What Do You Know*

Ans. 1—Every rotating body has a natural period of vibration. If run at the speed coinciding with this period, severe vibrations will be set up. This speed is called the critical speed.

Ans. 2—In 1824 and 1831 experiments were conducted in England by T. S. Dawes.

Ans. 3—The crank should be placed at about right angles with the line of centers so that in case the pin is worn the greatest pin diameter will be presented to the bearing halves. This eliminates danger of gripping.

Ans. 4—The fault will generally be found to be a short-circuit in the apparently good coil. This coil being short-circuited allows an excessive current to flow through the other and cause it to overheat and destroy its insulation.

Ans. 5—Flat valves, one for each steam and each exhaust port, equipped with pressure plates on their backs.

Ans. 6—In department-store passenger elevator service, the car is usually stopped at every floor by the operator. A system of doing this automatically, known as department-store control, has been developed. In this system, when the operator moves the control lever to the on position, the car gate and landing doors close, the machine starts and takes the car to the next floor where the gate and doors open automatically. The only function performed by the operator is to close the doors and gate, which are power-operated.

Ans. 7—Yes. The piston must stop as the crank turns past dead center.

Ans. 8—If the slip does not exceed 15 per cent, the pump is in good condition.

Ans. 9—Since the air blast will break the oil into finer particles than will a pump pressure, the pump-injected oil usually will travel the greater distance, but the injection air will give a wider diffusion to the oil.

Ans. 10—The fluid is a mixture of ammonia vapor and liquid. About 15 per cent is in a vaporous state, the exact percentage depending upon the pressure drop.

Because a Steam Gage is a certain amount ahead or behind a test gage at one point on the scale, it does not follow that it will be ahead or behind the test gage at other points of the scale, nor the amount of the variation. Consequently, a series of readings should be taken.

*The questions will be found on page 992.

A Boost for Scientific Research

AMONG the bequests to Princeton University, announced last week by President Hibben, was the sum of $460,000 for pure science research. Of this amount $50,000 was contributed by the Public Service Electric & Gas Company of New Jersey. This is not only a fitting recognition of the debt which the electrical industry owes to pure science, but indicates that there are leaders in the utility field who appreciate that scientific research must be stimulated if further improvement of marked magnitude is to be had.

Industrial research in this country has been highly developed and has had a large share in establishing our present enviable position. However, research in pure science must precede that in applied science, and were it not for the work of pioneers in the former we should not today be enjoying all the benefits of electricity, the radio, etc. Moreover, discoveries in pure science may have far-reaching application and thus be of incalculable value to mankind.

That we lag sadly in pure science research is a regrettable fact. Many capable men with leanings in this direction have been diverted to industrial research through pecuniary necessities. It is to rectify this situation that Secretary Hoover, heading a committee of the National Academy of Sciences, has undertaken to interest a number of leaders in the establishment of a substantial fund to further this purpose.

An Experiment Station That Should Be Better Known

COMPARATIVELY few in industry know there is a Naval Engineering Experiment Station at Annapolis, and fewer still know its facilities are at the disposal of manufacturers who have or think they have products applicable to Naval use. But further, its cooperation is extended broadly in problems of research and in all efforts toward securing better materials or improving efficiency and economy.

Captain Dinger, in his article outlining the purpose, scope and work of the Station, explains its relation to industry and sets down the simple procedure by which one may have tests made.

Many manufacturers do not have testing facilities in their shops, and such apparatus is usually expensive to install. By availing themselves of the opportunity to have tests made at nominal cost by the government, they may detect defects before getting into production, thus saving much unnecessary expense. At the same time they are likely to receive helpful suggestions, based on the experience of a trained personnel at the Station. Moreover, through competitive tests as well as development tests, manufacturers are often enabled to measure the relative merits of their products with those of their competitors.

Not only are the present facilities of the Station not fully utilized, but a greater volume of work would create a demand for still better and enlarged facilities which, in turn, would increase its field of usefulness. For some time the staff has been working closely with the American Society for Testing Materials to mutual advantage. Other engineering societies having research might well do likewise.

The important work which this branch of the Navy Department is accomplishing deserves full recognition to the end that its function as a direct means of contact between Naval material forces and technical engineers in industry may be better understood.

Enforcement of Safety Measures

NOWHERE has accident prevention been more highly developed than in the steel industry, and the results appear to have fully justified the effort. That accidents in the central-station field are proportionately twice those in the steel industry will surprise many, because the latter is generally considered the more hazardous industry.

The explanation, according to K. R. MacKinnon, speaking before the recent N.E.L.A. Convention at Atlantic City, lies largely in the attitude of executives and department heads. Not that central stations have not put both effort and money into accident protection, but having done so and adopted the most approved methods, there has been a tendency in some companies to delegate enforcement to subordinates. If instead, executives were imbued with a feeling of personal responsibility, better discipline, as concerns observance of safety measures, would result all the way down the line.

This applies equally, if not in greater degree, to industrial power plants in general. While managements are prone to give close attention to safety measures in manufacturing processes, the power plant is often either overlooked or the responsibility delegated to one possessing limited authority.

Mr. MacKinnon apparently has struck at the heart of the problem, and judging from results, the practices of the steel industry would warrant study and perhaps emulation.

Is Stand-by Equipment Justified?

RATHER than being unusual, it is quite common to find industrial power plants with peak loads but slightly over one-half the equipment capacity. Just how far this plan of providing excess capacity should go depends, of course, upon local conditions, but in the majority of instances the plant need only be large enough to meet the factory's peak load. Reserve apparatus increases the capital investment and the fixed charges, both of which should be kept as small as is consistent with operating economy.

It is not to be argued that any plant should be placed in a condition that the shutting down of a boiler must reduce the factory's operation, but it is seldom necessary to provide an extra unit. Boilers are rated far below their maximum possible output, and even though in every-day operation the rating is not exceeded, there is no reason why the shutting down of one boiler cannot be compensated for by the forcing of the remaining units. Steam engines are likewise capable of carrying large overloads, and in a two-engine plant it is possible to carry the entire load on one of the units even though at a temporary sacrifice of economy.

Industrials generally are not operating on a two-shift plan at present, and the idle twelve to sixteen hours offer ample time for ordinary power-house adjustments. For more serious troubles the present working week provides about forty hours for repairs. This removes most of the necessity for stand-by equipment. Even the insurance companies offering use-and-occupancy insurance recognize that excess equipment is not needed for protection as long as the existing apparatus can carry the load with a single unit out of commission. Inasmuch as insurance requirements are based on facts and the laws of probabilities, it would seem that a plant owner need not exceed the insurance requirements. By the elimination of idle machinery, or rather by the avoidance of installing excess units, capital costs would assume a less ponderous appearance. Power-plant machinery should be worked to capacity, as should any other machine.

Utilizing Byproduct Power from Industries

HIGH labor costs, low market prices and keen competition have caused an ever-increasing interest in byproducts from industrial processes as a means of making the operation more profitable or to reduce the cost of production and therefore better compete with market conditions. These byproducts have practically unlimited ramifications, but in industries such as steel and cement, waste heat and fuel are of prime importance. These offer opportunities for generating large quantities of power at low cost.

One of the largest sources of waste fuels in the iron and steel industry is from blast-furnace operation. These fuels are chiefly in the form of gas and coke breeze. After all the requirements of the furnace for power and for heating the blast are taken care of, there still remains a large surplus of waste fuel for power generation, for which a use must be found. On a blast furnace the average surplus power amounts to about two hundred kilowatt-hours per ton of iron produced. Therefore, a six-hundred-ton per day furnace will have a power surplus of about four million kilowatt-hours per month. Improved methods of utilizing waste fuels for power generation will increase this surplus.

Where steel mills are combined with blast-furnace operation, a market is available for utilizing the power from waste fuels. The increasing use of waste-heat boilers on steel-mill furnaces, combined with more efficient methods of burning waste fuels under boilers, is making available surplus power after the mill requirements are supplied. If some of the experiments now being made with anti-friction bearings on rolling mills, result in the power reduction that these initial installations indicate, the power required per ton of steel rolled will be greatly reduced. Some of these tests have shown a power saving of from thirty-five to sixty per cent, but it is too early to predict what the full results will be.

All these developments tend to increase power production from waste heat and fuels and decrease the power consumption in the process. This increases the power surplus or the possibilities of a surplus, and makes an outlet for this excess a more pressing economical problem. The most logical way of disposing of this power is through the local utility system. This has been attempted in some few cases and others are being considered, but not to the extent that is economically justified. In reducing fuel consumption per unit of power output, the last few years have seen remarkable achievements in power-station design and operation, but there remains the problem of reducing the fuel demands by a better utilization of the waste heat and fuels from industrial processes, even though much has already been done.

Many industrial power plants have attained the proportions of central generating stations, are operated with equal skill and supply a load where continuity of service must be assured. Therefore on this score there can be no objection to an interconnection between these plants and utility systems.

Power supplied to the utility system as a byproduct of an industrial process is dump power and will in many cases be worth only the coal it will replace in the central station. However, it can be produced at low cost, entailing in many cases little additional investment and operating expense. The reserve capacity in many industrial plants will be sufficient to utilize the surplus waste heat and fuel. Using the peak power from water-power stations in utility systems has been worked out to advantage. In a number of large industries the opportunities for using surplus power are even greater and should be given the consideration that their economic possibilities warrant.

Welding Helps the Generator Builder

WELDING is proving to be an important contribution to the fabricating art. Its latest application to the building up of electric generator frames is a striking illustration of its possibilities. It appears that a generator stator frame of any size, from the smallest to the very largest, can be made up of steel plate and rolled shapes in an astonishingly short time. Similar methods are used in the production of motors, and in many instances, rotor spiders and similar parts have been welded in successful production.

In addition to the saving of time, which is obviously a matter of considerable importance, there are other distinct savings. For example, no time or money is spent in the production of patterns. The serious loss of money and time arising from the discovery of defects in castings that have been partly machined has been eliminated. It is easier to provide ample space for ventilating ducts and the like.

In addition to these savings there is a reduction in weight of the finished stator of almost one-third, in comparison with the corresponding cast structure. This has made it possible in the case of larger units to wind stators in the shop that formerly had to be stacked and wound in the field because too heavy to be shipped complete. This simplifies the task of high voltage testing and facilitates delivery and erection.

In short, the welder has made possible the production of a better product in less time.

Ideas From Practical Men

Readers are urged to use this department for the exchange of practical operating information. A minimum of five dollars will be paid for contributions accepted

Engine Continued To Race After Throttle Valve Was Closed

To shut the throttle on a large engine that is over speeding and have its speed continue to increase, is likely to cause the most hardy engineer a little apprehension. This disconcerting event occurred in a power house containing three 300-ampere 600-volt railroad generators, driven by tandem-compound Corliss engines.

The first time it happened I was sitting at the desk, kind of drowsy, it being about 2 a.m. Suddenly the engine that was in operation started to speed up and I rushed to the throttle and shut it tight. The speed continued to increase and the governor balls were as high as they could go. The governor was acting on the valves all right as the dashpot rods were not picked up. The brushes on the commutator were sparking. The speed was very high, but all the lights in the plant were at about one-half their usual brilliancy. All this took place in a few seconds, and realizing there was some exterior cause, I ran to the switchboard and tripped the circuit breaker and the engine slowed down.

Going back to the engine and making an examination, I found everything O.K. After bringing the engine up to speed again and putting the generator on the line, everything went along fine and nothing more happened that night. The following night the same thing occurred, but I immediately tripped the circuit breaker and the engine slowed down. Unlike the previous night, when the engine was put on the line again it speeded up immediately. After several unsuccessful attempts to get it on the line, I began to make inquiries.

It was apparent that the generator was motoring, but I did not know why. After several phone calls had been made the cause of the trouble was located. A new substation, containing rotary converters, was connected into the same line as the plant. I knew the station was ready, but had not been notified that it was running. It happened that the day before the trouble started, the erectors had decided to run the rotary for a week before shutting down the steam station.

During the day, when the load was heavy, the voltage of the steam station was about 600. At night the load was light, and as the generator was over compound, the voltage dropped with the load and fell to about 500. There were no reverse-current relays or voltage regulators in the plant, so that when the voltage of the rotaries overbalanced that of the generator, the latter was motorized. The normal speed of the engine was 100 r.p.m., but when the generator was motorized, I judged it to be 200 r.p.m.

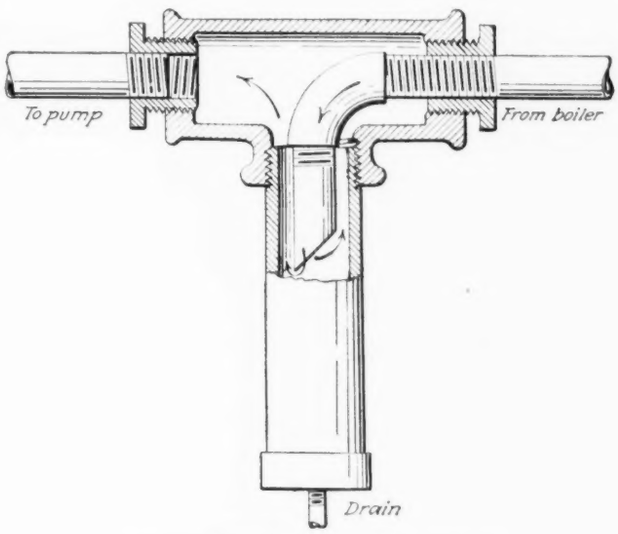
To eliminate the danger of overspeeding, the generator was shut down each night at 1 a.m. and the rotary allowed to carry the load. In the morning, when the load increased, the generators were again started.

Rosedale, N. Y. JOSEPH O'BRIEN.

Improvised Separator for a Steam Pump

In one instance a steam pump gave some trouble from water coming over into the steam end, when first started up. This was due to a long steam connection between the pump and the boiler. Of course, after the water had been cleared from the steam pipe, there was no further trouble. The engineer did not feel that he could reasonably ask the management for a steam separator, as the pump was used but part of the time, so he decided to make one from material on hand, that would, in his opinion, remove the trouble and serve its purpose as well as a manufactured one.

A tee was obtained of a size about twice the diameter of the steam pipe. Each end was fitted with a reducing bushing to the size of the steam pipe. The pipe leading to the boiler was provided with a long thread that entered the horizontal part of the tee sufficient for securing an elbow. A short nipple with one end cut at an angle of 45 deg. was screwed into the elbow and turned at a right angle to the direction of the flow of the steam, as shown in the illustration.



Separator made from pipe fittings

A piece of pipe 12 in. long was screwed into the bottom opening of the tee and the lower end capped as shown. A drain connection was made to the cap and led to a trap. The other outlet of the tee was connected to the steam pipe leading to the pump. When steam enters the elbow it is deflected, with such entrained water as may be present, to the bottom of the chamber, the steam rising and passing on to the pump in practically a dry state. R. H. RIDLEY.

Atlanta, Ga.

Heating a Building by a Water-Jacketed Gas Producer

When I was visiting, recently, the power plant of a Holland water-works station, where the installation of an exhaust-gas boiler was contemplated, the engineer in charge showed me a heating arrangement he had devised and installed. He had simply inserted a pipe coil in the water-jacket of the suction gas producer.

The water level in the jacket was kept constant by means of a ball-and-lever arrangement, and the steam produced was led underneath the grade in order to lessen the heat and to produce rich gas. The pumping engines were running on an average of 14 hours a day, and then the fire or the producer was kept burning during the night so that the water in the jacket was always hot.

The coil was connected into the building heating system so that the water in the coil, after warming up, flowed by gravity through the system.

This full-automatic gravity heating system has caused no trouble and it is reliable, inasmuch as no parts are subjected to the fire in the producer. During the winter, which on the whole is rather mild in this country, the temperature in the building was very comfortable.

Enschide, Holland. H. WEILAND LOS.

Revamping Return Lines

The sketch, Fig. 1, shows the return line, receiving tank and pump in a factory building that uses considerable steam for process work, both high- and low-pressure. The piping ran from 2- to 8-in., being made up of cast-iron pipe with bell and spigot joints. The trunk

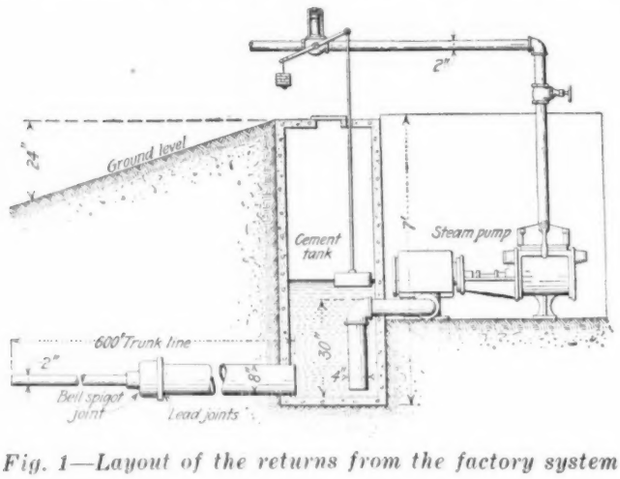


Fig. 1—Layout of the returns from the factory system

line was 600 ft. long, and about half of it was buried in the ground, with the other half in a trench. It was installed in 1917, and several unsuccessful attempts were made to get it working; the lead joints would leak and sections of the cast-iron pipe would crack and pieces blow out. The company refused to spend any more money on it and allowed the condensation to go to the sewer, although the plant used about 45 tons of coal per day.

Upon investigating, it was found that the ground level was about 2 ft. higher at the receiving tank than it was at the other end. The end of the suction pipe to the pump was 30 in. from the bottom of the tank, the tank being 7 ft. deep. This gave one the impression of a big pitch to the pipe when there was less than 2½ ft. in 600 ft., or $\frac{1}{20}$ in. to the foot. It will be seen from the sketch that the return line would fill with water for a considerable distance back, and with high-pressure traps discharging into it, water hammer set up, causing all the damage.

The suction pipe was extended to within 3 in. of the bottom of the tank as shown, and a float was rigged up to a piece of flat iron bolted across the wheel of a 2-in. valve at the pump and set to carry the lowest water level in the tank without interfering with the suction to the pump.

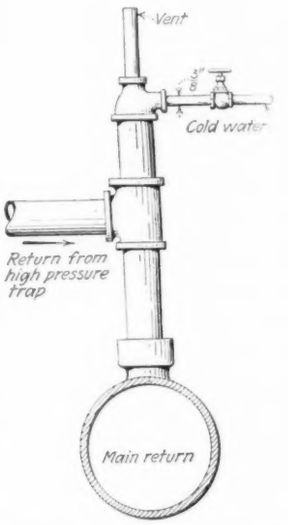


Fig. 2—Rearrangement of lines to prevent steam binding

It gave no further trouble, the high-pressure traps were overhauled, and where the returns entered the main, a vent was run up. This was provided with ¾-in. cold-water pipe capped on the end with a few small holes drilled in it, to supply a spray to prevent any steam from escaping, the vent preventing pressure building up in the main, as shown in Fig. 2.

The exhaust steam from a 500-hp. Corliss non-condensing engine was put through several hot-water heaters, the condensate being wasted, owing to the oil. To save the hot water a cast-iron tank was piped up as shown in Fig. 3. The water going to the main return was taken from the bottom of the tank, and as the oil floated on the top, none entered the return. By closing

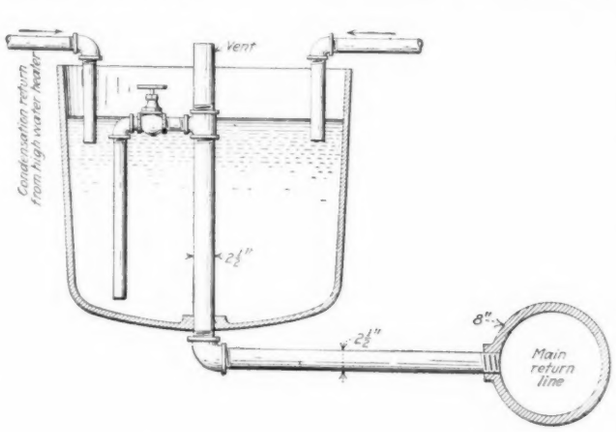


Fig. 3—How oil was eliminated

the valve in the gooseneck, the tank would fill up, and the oil could be skimmed off. In the meantime a boiler compound was made up, consisting of silicate of soda and a small percentage of caustic soda, and after its use there was not a trace of oil to be found in the boilers. The saving was estimated at 40 tons of No. 2 Buckwheat per week and the reduced cost of the coal burned in a few days paid for the cost of alteration. It is a situation such as outlined that makes engineering attractive.

New York City. THOMAS SHEEHAN.

Comments from Readers

The High Cost of Cheap Oil-Engine Operators

Beginning with the moment a man or corporation first contemplates the purchase of an oil engine, the question arises, Who is going to operate it? The advice received on this subject is generally so varied and contradictory, before the purchase is made, that it often becomes difficult to say or decide who is going to be engaged to operate it.

Despite all arguments to the contrary there is but one correct answer to this question. The most capable man available should be placed in charge. Naturally, we should not expect to pay the engineer in a 50-hp. plant the salary of a chief engineer of an ocean liner, nevertheless it is profitable to engage the best man the size of the job permits.

Not long ago I was called upon to make a sort of post-mortem survey of an oil-engine plant, the operation of which was being abandoned in favor of power purchased from a central station. The plant was in abominable shape. It was the most disorderly and filthy engine room I have ever seen. However, it was apparent to me that it could be reconditioned at a moderate cost and be made to generate power at a saving of about one-third of the price of purchased power, or $20,000 a year.

The owners of this plant were convinced that oil engines of every description are complete failures. They said that although the initial cost had been but $75,000, they had sustained a loss of fully a quarter of a million as the result of three years of constant interruptions in the operation of their mills. They were considering the reconditioning of the plant as a stand-by only.

They had permitted themselves to become involved in a lawsuit with the engine manufacturer and had expected that my report would help them to place the blame for existing conditions where they thought it justly belonged. However, I was unable to find any unsatisfactory condition that was not directly traceable to faulty methods of operation, and said as much.

According to their statement $7,500 had been saved on engineers' pay while bringing about the loss just mentioned. The manager said in justification of his policy: "I tell you that it is no fault of ours that these engines are in this condition. The man who sold them to us said they would run without engineers. He said we could start them up, lock the engine-room door and throw the key away; they would run just as long as the supply of water, oil and fuel lasted. They have been oiled, watered and fueled properly and we have gone them one better. We have had a man in the engine room all the time."

It was a 900-hp. plant, and the total daily pay of the engineers amounted to $10.

At one time it was thought that an engine foundation was settling and the engine becoming out of line, but no one was quite certain about it. Later, the question arose as to whether they had a sprung crankshaft. No one could tell. Then a piston seized, the crankbox bolts broke and the connecting rod came out of one side of the crankcase and cracked the engine frame. No one knew whether a vital part of the frame was broken, whether patching would serve or a new frame was needed. They were so completely at outs with the engine manufacturer that advice and replacement parts from that source were not available.

A consulting engineer was called in, and he recommended that after the engines be reconditioned capable engineers be engaged and that the chief alone be paid more than the combined wages of the two men who had been doing the best they could previously. In support of his argument that such a policy would be economical, he took his clients to a plant about fifty miles distant, where engines of the same make and power were giving excellent service under similar load conditions, at the hands of high-priced engineers. However, it was not possible to convince these men of the wisdom of changing their policy.

Two serious blunders were made, one by the engine manufacturer and one by the purchaser. The sales policy was to represent the engines as being foolproof and self-operating. A business policy of the purchasers was to pay as little as possible for what they bought, regardless of quality. Having paid a fairly high price for the engines, they felt that they had insured themselves against all future troubles. Therefore they took two stationary firemen out of a coal-fired plant and paid them the fabulous sum of 42 cents an hour and worked them 84 hours a week, assuring them that they would make their $35.28 each week for merely watching the wheels go around. The result was disastrous, as I have explained.

It is unfortunate that sales engineers will make extravagant claims in an attempt to close a deal, and we must take what some of them say with a grain of salt. However, we should use a little common sense in all affairs of this sort, and common sense teaches that we cannot expect much of men who have to work for a starvation rate of pay, and work long hours, but who, after all, spend these hour on the job not because they are deeply interested in their work, but because they can find no other means of making enough to keep the wolf from the door. We cannot blame them for obtaining and holding such jobs even though they are not capable, for after all they also face the one important problem of obtaining the necessities of life, even at the cost of machinery.

We should remain awake to the fact that perpetual motion has not been developed, and when we are confronted with the problem of securing engineers, we should bear in mind the one important fact that wages are a small item as compared to repair bills and consequent delays in plant operation. The man who takes charge cannot be obtained cheaply, since, to be successful, he must at least be capable of quickly grasping the essentials of oil-engine operation.

Woodbury, N. J. A. B. NEWELL.

Method of Measuring Condenser Air Leakage

One of the most persistent errors in engineering is the impression that air carries moisture as does a sponge. We frequently encounter phrases such as "the moisture carrying capacity of air," "the water holding capacity of air," etc. As a matter of fact the air has nothing to do with the moisture associated with it, the moisture existing by virtue of the vapor pressure consequent on its heat content.

On page 746 of the May 17 issue is an article dealing with the measurement of air leakage into steam condensers. The sentence, "However, it must be remembered that under vacuum conditions air has a much greater capacity for holding water vapor than at atmospheric conditions, consequently there is a considerable amount of steam passing through the bypass," implies a relation between the air and its accompanying moisture. It cannot be assumed that the authors of the article quoted are ignorant of the independence of the air and moisture because they later show a familiarity with Dalton's law of partial pressures which declares this independence. The comparison of the water "holding" capacities of air at vacuum and atmospheric conditions, however, indicates confusion and seemingly implies a belief in a relation between the pressure of the air and the amount of the vapor present. When informed engineers use such phrases as the foregoing, we must conclude that common usage has woven them into the language—engineering idioms they might be called.

If the pressure in a condenser is determined accurately and the temperature of the steam is found to be less than that corresponding to the pressure, then it is assumed that air is present, and its amount may be determined.

Some years ago I had a discussion with a friend on this subject—the "moisture carrying" capacity of air. It went something like this:

"You say that the air has nothing to do with the vapor associated with it?"

"Yes. Temperature, or heat only, influences it."

"Then if the air above the surface of the water were removed, there would not be an increase in the amount of vapor given off?"

"No."

"Do you mean to say that if I put a vacuum on the space above the water, there would not be an increase of evaporation?"

"It depends on what you mean by a vacuum. Exhausting the air alone does not affect the vapor pressure, which may already be less than atmospheric. But with a real pump that removes not only the air, but a portion of the water vapor, you would get increased evaporation because you have decreased the vapor pressure, and an increase of evaporation necessarily follows so long as the temperature of the water is maintained."

"Well, then, suppose I should pump enough air into the space above the water to double the pressure, wouldn't a portion of the vapor condense?"

"No. You would have doubled the total pressure, but would not have increased the vapor pressure. But, should you pump in some vapor, then there would be condensation because the vapor pressure has been increased."

"Then temperature only determines the amount of vapor present?"

"Yes. Should you pump air into the space until the pressure doubled and then raise the temperature of the water, the added vapor would increase the total pressure still further. Should you then remove the air, there would be no condensation of the vapor because you have not changed its temperature. Lowering its temperature will condense a portion of the vapor regardless of whether there is any air present."

"Then the air and the vapor exist entirely independent of each other—just as though the other wasn't present?"

"That's it! The amount and pressure of the vapor depend entirely on its temperature, and these can be determined from the steam tables."

"Do you think that the public will ever be trained to a correct statement of this phenomenon?"

"Of course, 'ever' is a long time, and no one is competent to place limitations on the possibilities of development with time, but one thing is certain—the layman will never use correct technical language so long as engineers use it incorrectly." C. O. SANDSTROM.

Los Angeles, Calif.

They Say They Do It, but They Don't

With reference to the article in the May 10 issue on the Union Plant of the Hercules Powder Co., in which an increase from 54.8 to 77 per cent is reported in the average over-all boiler efficiency through changes made in the plant, I have heard so much of these great engineering feats that I am getting sick of hearing this line of guff. I cannot mention how many I have personally investigated and found them all the same.

Last week I ran down a report of a large plant claiming 84 per cent efficiency, with chain-grate stokers burning No. 3 buckwheat. Another engineer was doing 75 per cent on a hand-fired job, another was getting 15 and 16 lb. of water per pound of coal. He was doing so well that he did not feel it worth while to figure efficiency. Still another was doing 84 per cent and his turbines were taking 12 lb. of steam per kw.-hr. with a steam pressure of 150 lb. Not one of these jobs had economizers or air heaters. Not long ago I asked what vacuum they were getting in a certain plant I visited, and the engineer replied, about 35 to 36 in., and he meant it. Another plant was reporting 22 lb. of water per pound of oil. All these wonderful results are attained by just plain engineering skill.

I have been in this business for thirty years, and I cannot get these marvelous results. No! I am not an old man and the world has not gone by me by a long shot. If I could do some of these wonderful engineering feats, I would not be looking for pay day. Sometimes when I hear of the surprising engineering skill, I think that Barrus and Kent were just a couple of plain dumbbells. If the central stations had some of these wonderful engineers, I honestly believe that instead of getting coupons with our tobacco we would receive a few kilowatts. I think I would like it. Saving several thousand coupons for a jackknife is rather annoying, but think of a handful of kilowatts to put in your lamp at night while you are reading of our engineer hero batting 100 per cent in the central-station boiler room. Cobb, Speaker and Babe Ruth would soon be forgotten.

I know many just smile when they hear of these high efficiencies, but to me it's no joke, I don't get a

kick out of it anyhow. I feel sorry for the honest ones because they are so puffed up that no one can explain to them that it might be a good idea to buy a few textbooks and study up. It may not then come with so much shock when the central station shuts them down. One of the plants previously referred to has only lately been shut down. The wonderful results and all were taken over by the central station. The chief is still in a daze wondering what it was all about. The old saying, "A little knowledge is dangerous," was only too true in his case.

I have obtained 77 per cent and occasionally 100 per cent, but only when one of the firemen thinks he is smart and tries to put something over on me, or when one of the flow meters becomes ambitious and does the quarter in 49 flat. When I hit 75 per cent, I look around to see what's wrong, just as I do when I hit below 70 per cent. At the end of the year my coal pile comes close to a balance, and the steam generated balances with steam used after making allowance for radiation. I have some 20 flow meters, and the manufacturer gives these meters the once over every three months. I want them correct. I am not going to kid myself or anyone else. I spend on an average $250 a month per boiler for maintenance. This includes the stoker and economizer. I generate about 55 million pounds of steam, and over a million kilowatt-hours a month; the gas temperature leaving the boiler runs 500 to 550 deg., sometimes 600, depending on the rating; I never did hit 450 deg. excepting when the boiler was on bank or the fire was going out.

I had a fellow tell me his exit-gas temperature was 400 deg. I was busy, but I dropped my work and hired a taxi to go and see this plant of perfection. Sure enough, the exit temperature was 400 deg. Well at last it was no bunk, but looking over the boiler room I noticed there was a dead boiler. I suggested that we close the damper on that boiler. A look of disgust came into my friend's face, but he knew I was somewhat hard-boiled, so the damper was closed. I now inquired how this 400 deg. was obtained. Simple as ABC. He had some bright ideas on changing his baffle walls. After looking over one of the walls that was being built, we strolled back to see our 400-deg. gas, but now it was 580 deg. The poor baffle man got his plenty. Why? Because my friend, the poor fish, did not take time to look around, but took things for granted.

Now, in the old days every engineer had an indicator and the great indoor sport was shooting pictures of the engine. Long and hard debates on the compression line were held. Consultations were held by the engineers, salesmen and their friends in some corner of the engine room. While these debates were raging, Casey, the fireman, was raising merry hell with the coal pile. Times have changed; the indicator, the compression line, and "Does the crosshead stop?" debates are gone. Now we have a new set of—well, just plain and fancy concoctions about efficiency. The boys in the old days did not intend to be untruthful. One said such a line is correct, the other fellow said so and so is the correct method! But today we have the gentleman with his slide rule and his figures, and he proves them, but not to me, he doesn't, because I know better. I know that the New York Edison, the Philadelphia Electric Co. and the Detroit Edison Co. do not average 77 per cent boiler efficiency. Plants reporting up to 82 per cent with 200, 300, 400 and 500 per cent of rating are true, but not over a long period of time. If small industrial plants up to 1,000 hp. do 68 per cent on an average, I say it's good. Some time ago I found a plant that was reporting exceptionally good results. I dropped in to investigate. They had a fellow as chief who knew he was not on a par with George Westinghouse and Steinmetz, but he did know what he was doing. He showed me about. They had induced and forced draft, combustion control and a whole lot of other fancy things. After getting all the dope, I asked the cost of a thousand pounds of steam. It was 63c., counting overhead and depreciation. Not so good. He had a second boiler room with a hand-fired stoker. With this outfit he was producing a thousand pounds for 42c. What was wrong? Nothing. The consulting engineer and the manager had only one thing in view —high efficiency. Had they given some thought to low steam cost, half of the equipment they installed would have been unnecessary and they would have saved some money.

I find that in most of these high-efficiency plants the men who report them have not looked into the facts and in many cases have no facts to base their claims on. This does a lot of damage to engineering as a whole, as much so as the old compression line debates did to the old timer while Casey wasted the coal in the boiler room.

The Union Plant reports a kilowatt-hour for 1.25c. What do they mean, steam cost only? I did not wish to include figures in this article, but it cannot be helped. If it's steam cost only, that is 40 lb. per kw.-hr., figuring labor, maintenance, water, oil and taxes. It is then, 0.795c. for steam and 0.455c. for the remainder of the items. If it is 40 lb. of steam per kw.-hr., it is very poor. If it is not steam cost only, then using 25 lb. of steam would equal 0.795c. and the 0.455c. would cover the remainder of the cost. Anyhow it puts the kilowatt in the same class with the 77 per cent efficiency. To my way of thinking it is not being done by Hercules Powder or any other small industrial plant, and if they honestly believe it, nobody else does who has had any experience.

HENRY JAMES.

Trenton, N. J.

Why the Exciter Failed to Generate

There have been several articles in *Power* recently telling about motor troubles of different kinds and how they were overcome, and it occurred to me that the following account might be of interest for undoubtedly many other engineers have been up against the same trouble.

The exciter connected to a 300-kw. alternating-current generator failed and had to be taken down for repairs. After various tests had been made, the armature was taken to the machine shop and the commutator turned up, but still it would not build up. Then it was taken to the electrical repair shop, where bar-to-bar tests as well as open circuits and short-circuit tests were made, but no trouble was found. Just about this time the manufacturer's representative happened to drop into the plant, and one look at the commutator was all he needed to diagnose the trouble, which was high mica between the commutator bars. When the mica had been cut down and the exciter assembled again, it operated perfectly.

T. H. REARDON.

Pittsfield, Mass.

New and Improved Equipment

Rooksby Improved Portable Facing Machine

The E. J. Rooksby & Co., 1042 Ridge Ave., Philadelphia, Pa., has recently brought out an improved portable facing machine for refacing cylinder flanges, etc. This type of machine was originally designed for refacing leaky ground joints, but in recent years, since the welding and brazing of broken cylinder flanges has become common practice, it has been adapted for cleaning up the face of the flanges after welding.

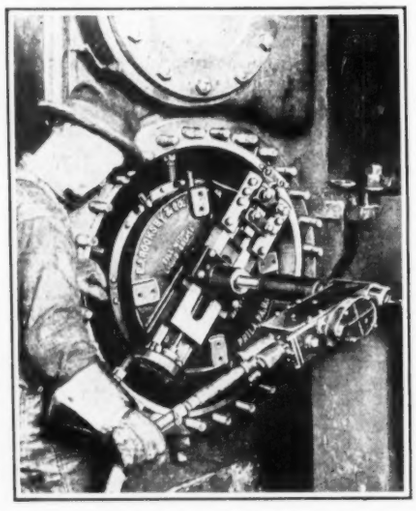


Fig. 1—Flange facing machine in position in cylinder

The illustration, Fig. 1, shows one of these machines set up in a cylinder,

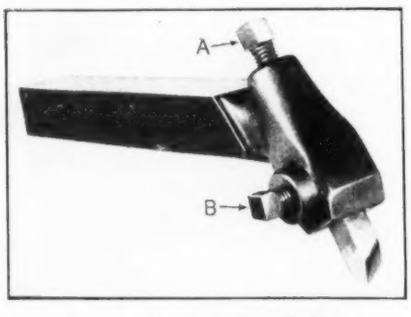


Fig. 2—Improved toolholder

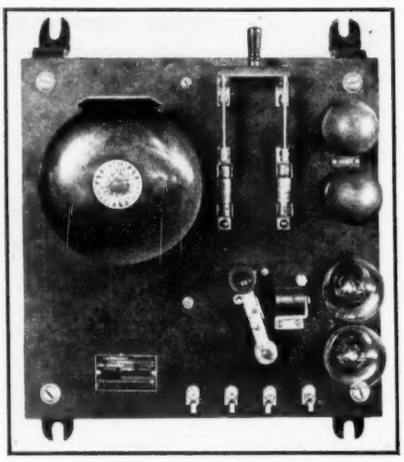
refacing the joint face. The four pads shown, each with two bolt holes, are for bolting four parallel strips to the machine to hold it parallel to the cylinder flange while setting up.

The recent improvements have to do largely with the reconstruction of the slide block and the addition of an adjustable toolholder illustrated in Fig. 2. The slide block in the machine as formerly made, had a tool bit in a square hole, but in the improved design it has clamps and studs to hold the toolholder, and the setscrew *A* at the top of the holder sets out the cutter.

A safety guard has been added to cover and protect the star wheel. These machines are made in five sizes to reface flanges from 18 to 45 in. in diameter.

New High-Low Water Alarm Signal Panel

A new General Electric signal panel has been designed for use in pump installations, especially in buildings, as a warning signal for calling an attendant in case of danger from overflow or emptying of the tank. The panel is governed by one or two float switches.



Assembly of signal panel

With this panel signal sounds immidiately when either the predetermined high- or low-level water is reached. The gong can be silenced by the attendant upon his arrival, and the silencing switch does not have to be manually reset after the float switch takes a normal position. High- and low-level signal lamps are provided, either of which lights when the predetermined level has been reached and remains so until the float takes a normal position.

The panel can be used for a one-level signal by omitting the float switch for the other level. It can also be used on pressure systems, but when single-pole float or pressure switches are used, it is necessary to add a relay in place of the other pole.

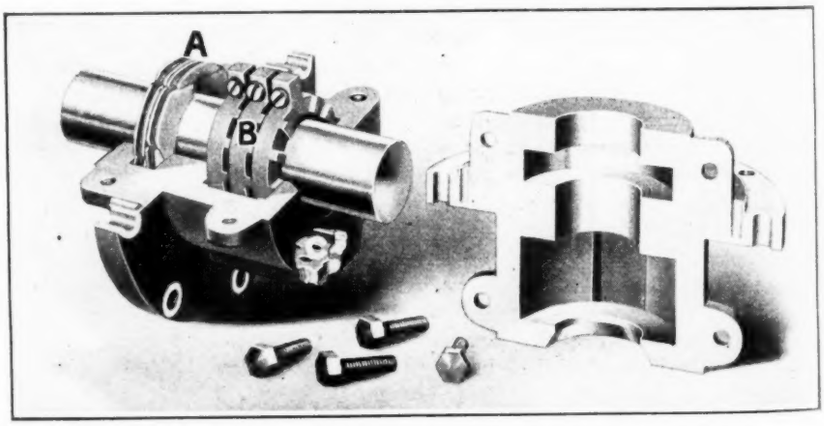
Garlock Oil-Return Wall-Plate Metal Packing

The new type of oil-return wall-plate metal packing for gas and air compressors illustrated herewith is a recent development of the Garlock Packing Co., Palmyra, New York. It is designed to replace the regular oil wiper packing used in the wall-plate stuffing boxes of gas and air compressors and to wipe the oil from the compressor piston rod and return it freely to the crankcase. In addition to the oil-wiper feature it is designed to take care of the vacuum and low pressures on certain types of power cylinders.

Referring to the illustration, *A* is the pressure-vacuum ring, which faces the cylinder side of the wall plate; *B* is the improved type of oil wiper rings and at *C* are shown the holes in the bottom of the split case through which the oil returns to the crankcase.

The packing is furnished in either a split or solid case, which is bolted to the partition-wall plate after the stuffing box is removed.

Among the advantages claimed for this new packing are: Decrease in the amount of oil consumed; elimination of oil deposits on the discharge valves, valve chambers, pipe lines and receivers; prevention of oil from being discharged by the cylinder into the compressed air and gas and the forming of carbon deposits and oxidation.

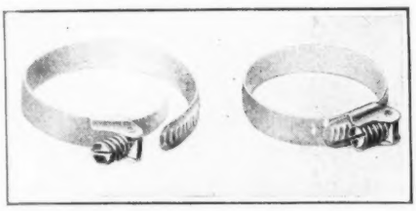


Assembly of cylinder and oil-return wall-plate metal packing

National Hose Clamp

A type of hose clamp of which one size will fit a wide range of hose sizes, has been brought out recently by the National Clamp Co., 16 East 41st St., New York.

The clamp consists of a band upon which is embossed a series of transverse ridges and depressions, forming



Clamp in open and closed position

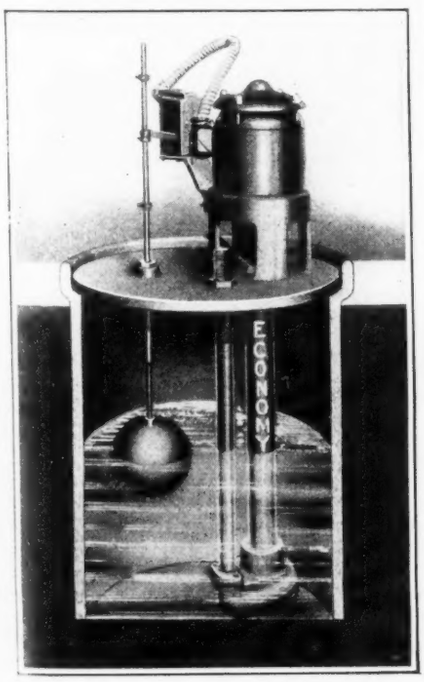
in effect, a toothed rack. The screw engaging with this toothed band is mounted on a trunnion.

In applying the clamp, the band is slipped over any part of the hose and compressed by hand, allowing the screw to swing into the position shown in the right-hand view. The screw, operating as a worm drive, feeds the band under the screw threads until it is as tight as desired.

The clamps are made in four sizes: Nos. 10, 20, 30 and 40. Size No. 20, for example, will fit hose from 1 in. up to and including 1¾ in. inside diameter.

Economy Small Capacity Sump Pump

To meet the demand for a heavy-duty sump pump of small capacity, the Economy Pumping Machinery Co., Chicago, Ill., have developed a 1-in. pump with a capacity of 10 to 20 gal. per min. against heads of from 10 to 18 ft.



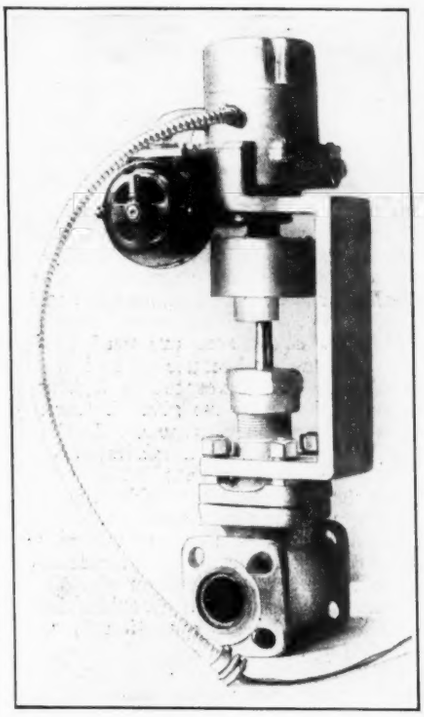
View of pump and float-operated control

The pump is suspended from a cast-iron cover upon which the vertical motor is mounted. The weight of the shaft and impeller is carried by the ball thrust bearings of the motor. The pump is fully equipped with float-operated automatic switch control.

Motor-Operated Unit for Ammonia Valve Control

The St. Louis Motor Valve Co., St. Louis, Mo., has brought out a motor-operated unit for general industrial application, but particularly designed for automatic ammonia valve control.

The unit is adaptable to practically any make of rising-stem globe valve,



Motor-operated unit installed on valve

and to practically any type of valve already installed. The working parts are enclosed in aluminum and cadmium-plated cast-iron housings, and bakelite and cadmium-plated metal form the electrical elements.

The operation of the valve requires 1¼ minutes from open to closed position, and the motor operates during this change only. A limit switch and coupling are interposed between the gearing and the valve stem.

Gelius Vegetable Fiber Heat Insulation

Based on the theory that the insulating capacity of heat insulation is not a quality inherent in the material employed, but depends mainly upon its structure or the number of minutely small air cells it contains, a so-called "Carbon Insulation" composed chiefly

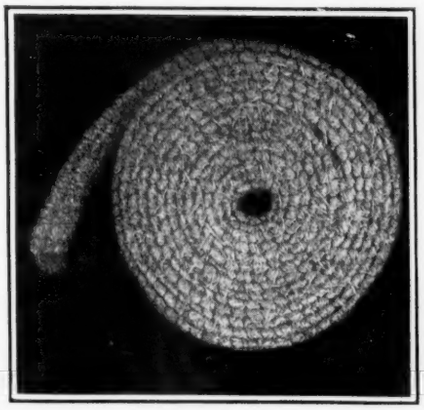


Fig. 1—Roll of wood fiber insulation ready to apply

of wood fiber has been developed by Philipp Gelius, of Munich, Germany.

Referring to the illustration, Fig. 1, the fibers are turned into rope and these ropes joined into belts of convenient width to suit the various sizes of pipe in general use. Although the insulation can be used generally for any temperatures, additional safety is obtained by submitting the material to a special treatment for use with the higher temperature.

In addition to wood fiber any similar pliable material such as grass or straw can serve as a basis for this insulation provided the length of the fibers is sufficient.

In putting the insulation in position, the pipe is first covered with a thin layer of clay mortar, then the insulation is wound on spirally, as shown in Fig. 2, and again finished off with clay mortar and a fabric wrapping.

Among the claims made for this insulation are ease of application, adaptability of one size of insulation to various sizes of pipe and other surfaces, and its tendency to carbonize and thus increase the number of air cells and consequently the insulating value. The insulation is being introduced in this country by A. R. C. Markl, 39 West Seventy-fourth St., New York City.

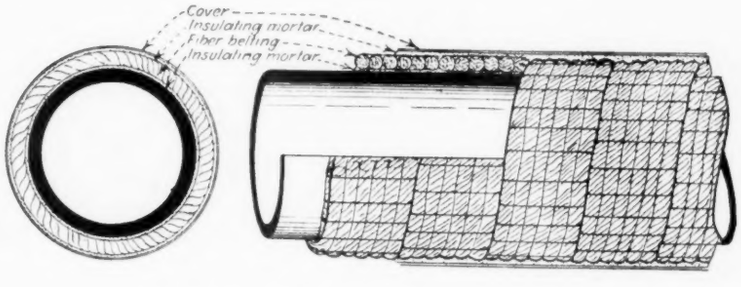


Fig. 2—How the insulation is put on the pipe

High Steam Pressure and Temperature at Crawford Avenue Station

By ALEX. D. BAILEY*

THE problems and experiences encountered during two and one-half years' operation of Crawford Avenue Station are discussed in this paper, presented at the A.S.M.E. Spring meeting. The discussion is not confined to the problems caused by high pressure and temperature.

CRAWFORD AVENUE STATION involves a rather radical change in operating conditions. A steam pressure of 550 lb. and a temperature of 725 deg. looked like a problem, but the preliminary studies and experience of the engineers, operators, and manufacturers eliminated many difficulties in advance, and most of the real problems of the installation have been occasioned by conditions entirely outside the questions of pressure and temperature. High capacity, together with the devilish characteristics of the Illinois fuel, has been responsible for more troubles than pressure and temperature combined.

Higher pressures were not used because at the time of the inception of the design 600 or 650 lb. was the limit for riveted drums and standard types of boilers, and the turbine manufacturers did not care to consider higher pressures for units of the size desired. While experience seems to indicate 750 deg. F. as the upper limit for temperature, it should be noted that the parts subjected to this temperature are few and relatively small, and it is probable that economic necessity will cause metals to be developed that will enable us to get the benefits of the higher efficiencies possible with higher temperature.

It might be expected that the changes described and the additional equipment required would increase unit investment costs, but the contrary was true, although the reduction was due to increased capacity of boilers and turbines. Since the two stations are owned by the same company, and the standard of design is the same in both, comparison can safely be made. Investment costs in dollars per kilowatt installed are as follows:

	Calumet	Crawford Units 1-2-3	Crawford Unit 4
Turbine equipment	27.46	29.38	23.33
Boiler equipment	40.00	43.25	32.13
Building	34.21	30.20	

Performance of Equipment

There have been turbine troubles, large and small, but relatively few were due to pressure and temperature, and these have been remedied. Blades, wheels, packings, casings, etc., subjected to high pressure and temperature have given no cause for worry whatever.

Because of the prospect of the new State Line Station to carry base load, unit No. 4 for Crawford Avenue has been designed for low load factor and frequent starting and shutting down without danger of mechanical troubles. The expense for the reheat installation used in earlier units could not be justified, and maximum capacity was desired in the space available. A steam-heated reheater has been designed to afford a limited reheat at greatly reduced cost. The saving is less, but the cost and space requirements are smaller and the maintenance will doubtless be less.

Vertical condensers are used to facilitate cleaning because of bad water conditions. With respect to tightness these condensers have given better results than any previous units. Leakage has been reduced to a minimum with little effort or expense. The rolled joints have given no trouble, and the packing used has been effective.

Little trouble was expected from the boiler-feed pumps, but considerable work proved necessary to make them perform satisfactorily. Troubles have been remedied, and operation is now satisfactory.

Piping and joints have given little trouble, and valves in general have been quite satisfactory. Defective steel castings, however, have caused no end of trouble, and there is yet to be found a line of fittings that will stand the service. Leaks develop after relatively short service.

Boiler-Room Problems

It is in the boiler room, where the greatest changes have been made because of high pressure and temperature, and where the effect of poor coal is noticeable, that most of the real problems have appeared. As attempts are made to improve efficiency by increasing furnace temperatures and reducing stack temperatures, the destructive characteristics of the fuel are met at every turn. The ash fusion temperature is 2,000 deg. F. or less, and there is a lot of it. The effects of sulphur are everywhere, and the excessive moisture of the fuel and its high hydrogen content cause high stack losses.

Experience at Calumet Station with water-cooled furnace walls has been so satisfactory that all subsequent furnace installations have been water-cooled. It has, however, been definitely determined that there is a limit to the amount of water-cooled surface that can be installed in the furnace walls. If this is overdone, the ignition of the coal is retarded and its final burning out is delayed. To maintain high capacity, some water-cooled surface is necessary, so that a compromise must be made, and a furnace with three walls having water tubes alternated with rows of refractory and with a refractory arch will probably be cheapest to install and most efficient. Chain-grate stokers are used. None of these furnaces has given any trouble whatever.

Makeup was originally treated in Zeolite softeners, sulphuric acid being added to maintain the proper sulphate-carbonate ratio in the boiler water. At high boiler capacities dirt was carried over into the steam lines and into the turbines, where it was deposited on the turbine screens and in the initial nozzles and blades. An evaporator has recently been installed in which all the makeup will be treated, and it is hoped this trouble will be eliminated.

There has always been considerable trouble from slag carried up by the gas and lodged between the tubes. An attempt was made to crack this off with a fine water jet, but this loosened the tubes in the rolled joints, so that it was necessary to rely on steam blowers for cleaning.

Safety valves have performed creditably. Feed-water regulators have done well, aided by differential pressure regulators. A decrease in the amount of blowdown would be appreciated.

Superheater troubles have apparently been due to poor circulation rather than to dirty steam and imperfect gas distribution, and the installation of steam baffles in the superheater boxes is helping the situation. Seldom, if ever, was any deposit found in burned out tubes.

The reheat boilers have been the greatest surprise of the installation. None of the expected troubles has developed, and the boiler can be operated with the steam temperature as a guide. The reheater elements have given no trouble.

The greatest source of trouble in the boiler room has been the economizers. Mechanical strains caused minute leakage which results in rapid deterioration due to the sulphur in the coal. After one and one-half or two years of service this leakage became so serious that it was impossible to keep the economizers in service. A new design has been worked out consisting of straight tubes with return bends bolted on the ends, with the joints entirely outside the casing.

Preheaters at Calumet have shown little corrosion, but after two and one-half years of service those at Crawford Avenue show considerable corrosion, largely attributed to moisture coming

*Superintendent, generating stations, Commonwealth Edison Co.

over with the gas from leaking economizers.

The use of 300-deg. air with chain-grate stokers introduced difficulties due to heating the chains, burning links and uneven fires, but this is being remedied by cooling the chain on its return or by means of water-cooled drums at the rear of the stoker. It is believed that somewhat higher temperatures can safely be employed.

In conclusion, Mr. Bailey said that the problems at Crawford Avenue have been the same old problems. Some bad conditions have been aggravated by high pressure and temperature, but usually there have been other contributing causes. No longer does the operating staff stand in awe of high pressure.

In high capacity lies the hope for reduced investment cost. If higher steam pressure and temperature will help to accomplish this end and give additional operating efficiency, the way is clear. If the two are opposed, then each problem will merit careful analysis, with emphasis always on the economic side.

Ethics Committee of Boiler Manufacturers Discusses Codes and Fair Prices*

We have all heard a great deal of ethics, the ethics of business, codes of ethics, etc. They are all good to read and are often printed and broadcast. They do some good and no harm. The idea is that they represent an ideal to aim at—seldom reached but to approach. A code of ethics is usually short, made up of six or seven items.

Can a code meet the situation as we really find it?

A code is a "drop in the bucket"—a puny effort toward furnishing rules for the conduct of business.

Our business life is deeper and broader than any code consisting of a few rules, which we may write.

Business is the carrying on of trade. Trade is an exchange of commodity or for the medium of exchange. Through trade men may be able to express themseleves to the fullest extent, to realize hopes, to build up character. To do these things requires effort or strife. When we get into the thick of the fight to get our share of the business, that is when we need more than a code of ethics. We need to be well grounded not only in the principles of honesty, justice and generosity, but in the principles of good business as shown by recent developments in the business world.

Competition may be divided into two classes, creative and destructive. The first kind develops an industry and makes for progress. The second is a scourge that destroys. The victims cease to thrive and wither and die. Creative competition is such that those engaged are making an effort to produce something better and better for the service of mankind and expect to receive a just reward for their effort.

There can be no quarrel with the manufacturer who strives to make his goods cost him as little as possible. We all are endeavoring to cut our costs. There surely can be no objection to his making his product better if he can and so desires.

He should, however, know his costs, his real costs including overhead (which is a part of cost as much as the cost of material) and should have a profit on his work. If this is not secured, the transaction is unethical.

Why should we say the transaction is unethical if a fair profit is not made?

First, because there is not a just return to the company, to be used in many ways besides giving a fair return on the investment. There is the interest of the community in which the plant is located. Is it not right and proper that a business enterprise have a part in the upbuilding of a community in ways not possible through taxation?

Second, because it deprives the employees of something it is difficult to describe. After all, it is the business of our industrial plants and business houses in general to make men. We can do a better job of this if we have means to work with. This work is called welfare work mostly.

When the one-price stores came into existence, people welcomed them. Why? Because the idea was fair or ethical.

Where are we today? Still in the horse-trading stage so far as selling methods are concerned.

It is not fair. It is not right. It is *not ethical*. Some may say we have company. That does not change the situation, but the situation can be changed. It is possible to make a fair price based on cost and profit required and make it firm, regardless of purchasing agents.

How can a code, including a few rules, be made to cover the vast field of business experience? The most effective code is written in the hearts of men, and if these be right, a great step has been taken toward prosperity in business.

*Presented at recent meeting of American Boiler Manufacturers Association.

Color Changes in Refractories*

The change in color of refractories in service is quite common and is often the source of considerable conjecturing as to the causes and effects. Such changes in the appearance of the brick may be the result of the action of various gases in altering the material chemically, or by removing certain constituents by volatilization or through deposition of volatilized foreign material within the brick.

To determine the color change made by various gases, small cubes of magnesite, chrome, diaspore, low and high iron clays and silica bricks were exposed to the action of sulphur dioxide, carbon monoxide and chlorine gas. The results of these tests are briefly outlined as follows:

The sulphur dioxide treatment had practically no effect on the color of the chrome, diaspore, and high and low clays, while the magnesite bricks were slightly bleached. In the silica bricks the sulphur gas produced a strong pink-brown coloration. This color is identical to that of the so-called spotted silica which often forms so mysteriously during manufacture. It is believed by many that this spotting is caused by certain undesirable types of ganister and that the spotted portions of the brick are of a different chemical composition. This work indicates that any ganister will spot if given the necessary treatment and that there is no appreciable difference in the chemical composition of the spotted areas.

The magnesite was bleached by the carbon monoxide gas, making it a dirty white color with a slightly brown tint. The chrome brick was unaffected, while carbon was deposited in the diaspore, low and high iron clays, and silica bricks, darkening all of them.

The chlorine gas bleached all the samples except the chrome brick, to which it imparted a dark green color.

Chemical analyses were made of all the samples tested and showed that in most cases very little change in composition resulted from gas treatment. Marked changes of color do not necessarily mean a significant change in composition as determined by the usual methods of analysis. Since both carbon-monoxide and sulphur-dioxide gases are present in the furnaces of most boilers, these observations may serve to explain the color changes sometimes found in furnace refractories.

*Abstract from American Refractories Technical Bulletin.

Workman Held Not Entitled to Compensation for Life

In Golconda Portland Cement Co. vs. Industrial Commission, 153 N. E. 594, the litigation involved the injury of a double hernia sustained by a workman as a result of lifting a heavy object during his employment.

It was shown that the employee had worked a little since the injury but was unable to assist in lifting.

In holding the injury not total, the Court said:

"An award for permanent total disability and a pension for life is justified only in case the employee is rendered wholly and permanently incapable of work as a result of the injury of which complaint is made, and the burden is upon the applicant to establish, by competent evidence, the legitimate conclusion that the accidental injury produced total and permanent disability . . . . While the evidence in this case tends to show that it is reasonably certain that defendant (workman) will be partially permanently incapacitated by reason of the hernia unless it is reduced by an operation, the evidence in the case fails to show that it is reasonably certain that he will be permanently totally incapacitated. There is therefore in the record no basis for an award for permanent total disability and a pension for life."

At the end of 1926 the hydro-electric development of Switzerland amounted to 1,867,000 hy. Of this total 46 per cent was developed by private undertakings, 17 per cent by local authorities, 26 per cent by cantonal and other authorities, and 11 per cent by the Swiss railway authorities, according to *The Engineer*, London.

Modernization of Industrial Power Plants

BY C. G. SPENCER

THE importance of modernizing industrial power plants is indicated by its coal consumption, which in 1923 was 31 per cent of the total. This paper, presented at the Regional Industrial Power Meeting of the A.S.M.E. at Erie, Pa., discussed various methods of improving the industrial power plant.

PRESENT-DAY practice had its beginning at the start of the century, when the engine or water-driven line-shaft transmitted energy through belts and electrification of industry first became possible. Electrification has steadily gone forward, until now it is practically universal. The steam-electric plant has assumed first place in the generation of energy, with the result that unusual effort has been made to improve its efficiency. Since the War marked economies have been made, public utilities having led in this field.

The problem facing the industrial manager, with this whole art in a state of flux, is to determine how far to go in adopting improvements. He has to consider that power is an incident in his manufacturing problems, while with the utility it is the principal product.

In plants that have been electrified probably the simplest and most inexpensive way of modernizing the plant is to change over to purchased power. Such a changeover is not always economic or possible, as in the case of the isolated plant.

There are many industries, particularly those employing heat processes, where power can be generated more economically by using the prime mover as a reducing valve between boiler pressure and the process mains. Mixed-pressure turbines and bleeder turbines for both process steam and feed-water heating are now available. Where bled steam replaces an existing system, a study is required of electric auxiliary drives in place of the existing steam-driven units. If there is sufficient electrical capacity in the main unit, it will often prove economical to replace the low-efficiency steam-driven auxiliaries.

Waste Heat Boilers

There are also industries where waste heat is available for steam generation, and industries in localities not economically served by central stations. It is for these cases that interest centers in the boiler room, where the greatest economy can be made and where advances have been most rapid in the last few years. There is a tendency to an effort to produce high thermal efficiencies, expressed most commonly as B.t.u. per kilowatt-hour or in cents per thousand pounds of steam for coal and operating labor when the true measure is the annual cost with fixed charges added to the operating expense.

There is a marked trend in selecting boilers for industrial plants for larger units and fewer. This reduces the first cost of boilers, settings, piping and structures, as well as operating labor and maintenance. It often permits, in the modernization of existing plants, the utilization of a structure originally designed to house a larger number of small boilers.

It is not possible to discuss the number and sizes of boilers without considering rating. Although boilers have been operated at ratings as high as 400 and 600 per cent, the engineer will be wise in adopting a more moderate figure. The troubles in an under-boilered plant are cumulative, and the severe punishment incident to excessive rating usually requires a high percentage of boiler outage with a demand for even greater performance on the remaining units. A conservative rule is to design so that one boiler may be out for a complete external and internal cleaning and furnace repair without loading the remaining boilers above 300 per cent rating. This means, in a plant with two boilers, that the normal operating load is at 150 per cent, which is quite often the point of highest efficiency. In a plant with three boilers the normal operation would be 200 per cent.

Pulverized Fuel

Furnace volume and heat release expressed in B.t.u. per cubic foot of furnace volume per hour largely determine the boiler performance, whether with oil, gas, stokers or pulverized fuel. A definite value for this cannot be given, as it depends on factors such as the type of fuel and furnace construction. The advent of water-cooled walls and ventilated settings has raised the possible heat release per cubic foot of furnace volume to more than 40,000 B.t.u.

The advent of pulverized fuel in what heretofore had been the field of the stoker has brought about big improvements in stoker design and performance. The present furnace, with its higher efficiency and lower maintenance, has largely been developed to meet the requirements for burning pulverized fuel.

In the field of pulverized fuel the bin and feeder system has in the past been the more popular system for large plants. There is now a tendency both for small and large plants toward the unit system. Unit mills of high-speed impact type, slow-speed tube mills and vertical medium-speed mills of the bullring type are now in successful operation.

The fear of an ash nuisance and the explosion danger are factors that have been adverse to pulverized fuel. Both electrical and mechanical dust-removal systems are available and in successful operation. The explosion hazard cannot be ignored, but experience has developed designs to guard against this and to minimize the effect of an explosion should one occur.

In industries releasing large volumes of high-temperature gases, such as steel plants and cement mills, the waste-heat boiler is justified unless an extremely low power rate is available. In most of these applications the gas is laden with abrasive dust, which presents a problem in its collection and disposal, as well as in the selection of induced-draft equipment not subject to rapid wear.

Economizer and Air Preheater

The justification of economizer and air preheater depends on fuel price. In general the economizer field is in plants where low-head heat or steam bled from a turbine is not available for feed-water heating and the air-preheater field is where the heat from the exit gas cannot be used for feed-water heating.

The operation of large boiler units at high ratings makes it essential to maintain a clean surface on the inside of the tubes and drums, not only to obtain high efficiency and prevent tube failures, but to lengthen the interval between shutdowns for cleaning. In the modern plant hard scale-forming solids should be removed from the feed water before it is allowed to enter the boiler drum.

There is a tendency in modern industrial plants to reduce the element of manual control, replacing it by automatic control, which acts with less delay and greater precision, resulting in a substantial saving. It should not be installed unless the management is prepared to provide high-grade attendants to supervise its operation.

IN A PAPER ON the Trend of Fusion Welding Research, presented at the annual meeting of the American Welding Society, J. R. Dawson calls attention to the development of high tensile-strength steel welding rods from which 58,000 lb. per sq.in. tensile strength in single V-welds could regularly be secured. He reports that a California public utility company, in an investigation of welding pipe lines of 3 to 12 in. diameter, had found a saving of from 10 to 29 per cent in favor of the high strength rod.

News in the Field of Power

J. M. Goodell, Water-Works Editor and Leader, Dies

John M. Goodell, for many years a prominent figure in the highway and water-works fields of engineering, and a former editor of *Engineering Record* and an associate editor of *Engineering News*, died in New York City, June 21, at the age of 60 years.

Mr. Goodell was born in Worcester, Mass., Aug. 3, 1867, and was graduated from Worcester Polytechnic Institute in 1888 with the degree of bachelor of science in civil engineering. Two years later he joined the editorial staff of *Engineering News* as an associate of Arthur M. Wellington, leaving two years later to become an associate editor on *Engineering Record*. After two years with that publication he was made assistant secretary of the American Society of Civil Engineers, but left that position in 1897 to return to *Engineering Record*.

EDITOR OF *Engineering Record*

After five years of editorial work Mr. Goodell joined the staff of Joseph H. Wallace, engineers, as a resident engineer on paper-mill construction at Sault Ste. Marie. In 1903 returned again to *Engineering Record*, this time as editor. He retired from that paper in 1912 and E. J. Mehren, vice-president of the McGraw-Hill Publishing Co., Inc., was made its editor.

He collaborated with Metcalf and Eddy in producing their three-volume work on "American Sewerage Practice." Prior to the World War Mr. Goodell was engaged in highway organization work and prominently identified with the American Highway Association, which he helped to establish. During the war he was employment manager, first for the production division and then for the entire Emergency Fleet Corporation. During the last months of the war he was acting chairman of the National Highway Council which had charge of materials, transportation and labor for road work. Latterly he had been in charge of publicity and advertising for Babcock & Wilcox, New York City, and he had been editor of the *Journal* of the American Water Works Association.

He was an affiliate of the American Society of Civil Engineers, a member of the American Society of Mechanical Engineers, the American Water Works Association and of the New England Water Works Association.

Mr. Goodell is survived by his wife, Letha Loring Goodell, a son, John Boyden Goodell, and two daughters, Dorothy Wolcott Goodell and Barbara Letha Goodell.

New England Power Heads See Conditions Better

The executive committee of the New England Power Association, which controls the Narragansett Electric Lighting Co. and the United Electric Railways Co., met recently at the office of Luke C. Bradley, president of the Narragansett and member of the committee.

The executive committee men are impressed with the recent improvement shown in New England business conditions and feel optimistic regarding the future, Mr. Bradley said.

Philadelphia Electric Co. Officials Inspecting Nearly Completed Conowingo Dam. Center, Walter H. Johnson, President of the Company. On the Left Is Governor Albert E. Ritchie of Maryland Greeting Ed. T. Stotesbury

Marketing Power Under Cost Ruled Illegal

A substantial victory was gained by O. S. Spillman, Attorney-General for Nebraska, in his effort to prevent the Interstate Power Co. of Iowa from selling electric energy below cost in the City of Hartington in competition with the newly erected municipal plant, according to report published by the *Christian Science Monitor*, June 21.

Judge Mark J. Ryan of the District Court, held that the cut in price was made for the purpose of eliminating that competition and that a conspiracy had been entered into with that object in view by means of advertising and cutting rates.

The Attorney-General wanted the court to order that "unfair competition" cease at Hartington and that the Interstate company be ordered to reduce its rates in the other 43 towns it serves in the northeastern section of the state.

The court held that it was without power to prevent competition, but that the Interstate Power Co. could not be permitted to wreck the city plant by selling current in competition at less than the cost of production and make up its losses there by excessive rates elsewhere. It held that in the absence of a showing that rates in other towns served were excessive, it being a matter of "common knowledge" that rates in one town are not conclusive of the fairness of rates in other towns, he would deny that portion of the Attorney-General's request.

Power Increase Planned In Mexico

An extensive construction program designed to increase Mexico's power supply has been recently undertaken, according to a report of Acting Commercial Attaché George Wythe, Mexico City, made public June 17 by the Department of Commerce. The program calls for the expenditure of approximately $14,000,000, it is stated.

The Mexican Light & Power Co., Ltd., has started to overhaul existing plants and distribution systems, and to develop new sources.

In the Necaxa district one of the most extensive systems of tunnels and canals, 60 kilometers long, has been built to divert the waters of the Necaxa River and of 25 other smaller streams between Necaxa and Zecatlan into the great reservoirs at Necaxa (Tenango, Nexapa Los Reyes, and Laguna, which hold more than 171,000,000 cubic meters of water.

To utilize the potential power of these stored-up-waters, generating plants have been constructed at Necaxa, Tepexie, Laguna No. 1 and No. 2, and Tezcapa.

New England States N.A.S.E. Meets at Portland

The New England States Association of the National Association of Stationary Engineers held its annual convention at Portland, Maine, June 16-18. Business sessions were held in the Council Chamber at the City Hall. Seventy-one delegates presented their credentials.

At the opening meeting the delegates and visiting engineers listened to addresses by State Senator Frederick W. Hinckley, Harry A. Brinkerhoff, city manager, Chester A. Jordon, president of the Chamber of Commerce, and Judge Max L. Piansky, as hosts representing the city. The members of the Association who made addresses included Hollis C. Pettingill, chairman of the local committee; Andrew A. Waite, past president; Thomas H. Clark, president; Frank E. Guth, past president; Freeman L. Tyler, of the New England Association; Theodore N. Kelsey, William J. Reynolds, Patrick H. Hogan and Dudley H. Kimball, past-national presidents, and Elmer L. Bassett, of Hartford, national vice-president of the N.A.S.E.

Power Appliance Exhibit Followed by Entertainment

In the auditorium of the City Hall an exhibition of power-plant appliances and supplies was held, sixty-eight booths being occupied by fifty-nine exhibitors. Entertainment for the delegates and visitors included a visit to the Cape steam station of the Cumberland County Power & Light Co., a smoker, a ride around the city to the points of interest and a shore dinner.

The election of officers for the next term resulted as follows: President, Freeman Tyler, of Taunton, Mass.; vice-president, John A Bakstran, of Fitchburg, Mass.; Secretary, Charles Powers, of Cambridge, Mass.; Treasurer, Walter H. Damon, of Springfield, Mass.; Conductor, Joseph Kelby, of Providence, R. I.; doorkeeper, John Mills, of Manchester, N. H.

The next convention will be held at Hartford, Conn. As yet the date has not been decided.

Park Interests Oppose Power Project at Great Falls

A formal resolution opposing the development of power at Great Falls on the Potomac River was adopted June 20 by the National Capital Park and Planning Commission.

Members of the commission, after a day spent in traversing the site of the reservoir above Chain Bridge, came to the conclusion that Great Falls and the gorge below the falls should be preserved for park purposes.

It was held that the development of power would destroy the chief scenic values of the area.

Tests Show Performance of German 3-Cylinder Turbine

In the central station at Bielefeld, Germany, has recently been installed a 10,000 kw. three-cylinder tandem-compound turbine. It is designed to operate at 165 lb. pressure, 572 deg. F. total steam temperature, and 3,000 r.p.m. The high-pressure cylinder consists of one impulse stage and 11 reaction stages. The intermediate cylinder has 12 reaction stages and the low-pressure double-flow cylinder has two sets of five stages.

This unit has been subjected to exhaustive test the more important results of which are given in the table. While the results do not indicate any unusual economies, they are of interest because of the unusual three-cylinder construction in a machine of this size.

It will be noticed that the heat rates and efficiencies reported are based on the heat in the steam entering the turbine, no account being taken of the heat returned in the condensate. The heat rates are therefore slightly high and the efficiencies low.

TEST RESULTS ON 10,000 KW. TANDEM-COMPOUND TURBINE

Test Number	1	2	3	4	5
Load, per cent capacity	100	75	50	25	0
Generator output, kw.	10,866	7,813	6,498	2,610	0
Generator efficiency, per cent	95.72	94.90	94.17	88.75	0
Total steam consumption, lb. per hr.	125,685	92,836	77,249	37,346	8 730
Steam rate, lb. of steam per net kw.-hr.	11.56	11.88	11.90	14.31	...
Pressures					
Before throttle valve, lb. per sq.in. abs.	176.8	177.3	176.3	181.9	175.8
Turbine exhaust (lb. per sq.in. abs.)	1.29	1.12	1.02	0.73	0.69
Steam Temperatures					
Before throttle valve, deg. F.	614.3	621.8	630.1	636.1	601.2
At turbine exhaust, deg. F.	110.5	104.9	101.7	90.7	144.7
Specific heat in steam before throttle valve, B.t.u. per lb.	1,329.3	1,332.5	1,337.8	1,339.6	1,3212
Heat rate, B.t.u. per net Kw.-hr.	15,357	15,833	15,913	19,167	...
Thermal efficiency, per cent	22.2	21.56	21.45	17.80	0
Engine efficiency (Rankine) referred to net Kw., per cent	80.00	75.85	74.50	59.00	0

Installs Large Stokers for Canadian Paper Mills

The Anglo-Canadian Pulp & Paper Mills, Ltd., Quebec, Canada, has purchased for installation in its new plant at Limoilou, P. Q., three Taylor stokers embodying a number of recent developments to improve operating results, even with low-grade coal, and to reduce maintenance costs.

These stokers, which will underfeed coal a distance of 16 ft., will be nine units wide and will be equipped with large rotary ash discharge rolls. They will be installed under 12,500-sq.ft. boilers using 395 lb. steam pressure. Normal operation will be at 220 per cent of boiler rating, but the stokers will be able to fire the boilers at 330 per cent of rating when necessary. This is equivalent to the evaporation of 83,300 lb. of steam per hour continuously, or 125,000 lb. per hour for peak loads. Ordinarily, three boilers will be kept on the line, but when necessary two boilers will be able to carry the load.

Dominion coal of 13,300 B.t.u. will be burned with air preheated to 320 to 350 deg. F. This coal has an ash that fuses at 1,850 deg. F., is high in sulphur and iron and is regarded as a troublesome coal to burn.

Water walls will be used on the side walls, bridge wall and front wall. Those

Annual Convention of the New England States Association of the National

on the side wall will be of a newly developed type, consisting of cast-iron blocks bolted to tubes that parallel the slope of the stoker fuel bed.

A hydraulic drive has been developed for these stokers, in which a Hele-Shaw hydraulic pump coupled to a Hele-Shaw fluid motor are utilized as a hydraulic transmission giving an infinite number of stoker speeds from zero to a maximum. In addition to the speed control of the entire system of rams that is obtained in this way, there is the usual control of the speed of individual sections of the fuel bed with reference to adjacent sections that is standard construction on this stoker.

Steel Supporting Plates

Another new feature in these stokers is the use of steel supporting plates that extend the entire distance from the front of the stoker to the bottom of the ashpit without intermediate columns. Rollers that support the bases of these plates allow for the expansion and contraction of the stoker structure as a whole.

The deep ashpit provides for burning out practically the last traces of combustible from the ash. Hele-Shaw hydraulic pumps will also be used for operating the ash discharge rolls.

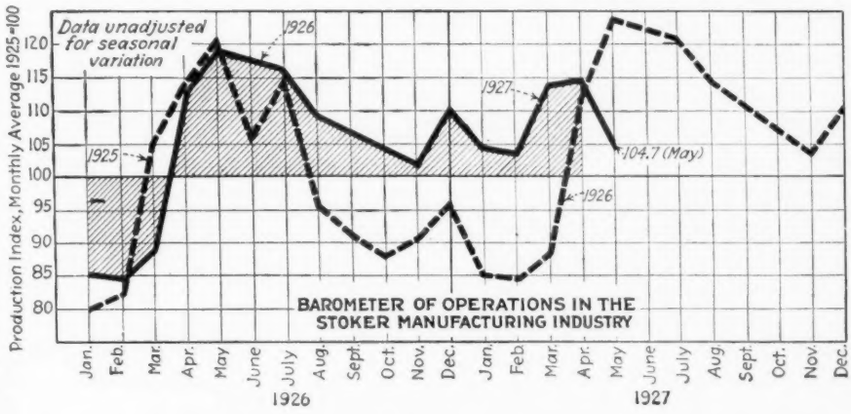
The stokers, water walls, hydraulic drive and other auxiliary equipment are being furnished by the American Engineering Co., of Philadelphia, who have made similar installations for several plants in the United States. Through the office of George F. Hardy, consulting engineer for the owners, a general contract covering practically the entire boiler-room equipment has been awarded to the Affiliated Engineering Companies, Ltd., of Montreal, who handle the Taylor Stoker in Canada.

New G.E. Vice-Presidents

C. C. Chesney, W. R. Burroughs and C. E. Eveleth have been elected vice-presidents of the General Electric Company, taking on responsibilities of the manufacturing department. F. C. Pratt was in charge of both engineering and manufacturing up to Jan. 1, when he resigned on account of illness.

Stoker Production Falls in May Output

Power presents herewith a new barometer of activity in the stoker manufacturing plants of the nation. This barometer, which will be published monthly in *Power*, will be based upon the monthly consumption of electrical energy by these manufacturing plants. A similar barometer has been issued monthly since last December, covering the operations of the boiler manufacturing industry. Electrical power enters into the actual production activities of both of these industries and industry in general, to such a degree today that any reaction in the industrial life of the nation is immediately reflected in the demand for electrical current by industry as a whole or any unit industry. Based upon extensive study that has been given to the subject, it is believed that electrical energy consumption by manufacturing plants is one of the best barometers of industrial operations available today. This is particularly true of industries where large quantities of process steam do not enter into the problem.



In the accompanying barometer of operations in the stoker manufacturing plants of the country, the actual monthly energy consumption is compared to the monthly average for 1925, the monthly average for 1925 being given a rating of 100. In May, for instance, the activities in the stoker manufacturing plants were 4.7 per cent above the monthly average of activity in 1925, and in February of last year 15.2 per cent under the monthly average for 1925. No correction has been made for seasonal variation, the figures being a direct reflection of the energy consumption by the same reporting companies each month. The monthly index for 1925 and 1926 has been carried forward as a dotted line, so that the activities of any month during 1926 or 1927 can be compared directly with the activity of the same month of the previous year.

During the first four months of the present year the stoker industry appears to have operated above the operations of the same month of last year, but May reports indicate a drop under last year. The figures for May are preliminary, and more complete reports may raise the operations closer to May of last year. The downward trend during May, however, is in line with the general trend in production experienced by the boiler manufacturing plants since the opening of the year.

These barometers will be further perfected as to basic information. They will be issued monthly and reprints will be furnished to those interested upon application.

Association of Stationary Engineers, Meeting at Portland, Me., June 16-18

Personal Mention

W. W. Schettler is now chief engineer for the Foos Engine Co., Springfield, Ohio.

George F. Noltoin has been appointed mechanical engineer by the Foos Engine Co.

L. B. Winton has recently been appointed designing engineer of the Brown Instrument Co., Philadelphia, Pa.

E. M. Hewlett as consulting engineer, switchboard department of the General Electric Co., has been announced. The appointment was effected as of June 1.

R. T. Kent, formerly superintendent of prison industries for the State of New York, is now general manager of the Bridgeport Brass Co., Bridgeport, Conn.

E. W. Fitch has recently been appointed manager of St. Louis office of the Bailey Meter Co. He was formerly engaged in field work in New England for that company.

G. E. Wearn is now central station sales manager for the Westinghouse Electric & Manufacturing Co. Mr. Wearn spent five years with the General Electric Co. in the steam-turbine department, two years with the Allis-Chalmers Co. in the erecting and testing division and three years as consulting engineer on steam-plant design before entering the employ of the Westinghouse Electric & Manufacturing Co. eleven years ago.

Business Notes

North American Light & Power Co.—The company has issued its annual report for 1926.

The Plibrico Jointless Firebrick Co., Chicago, Ill., is now publishing *The Firebox*, a magazine of interest to refractory users.

The Grindle Fuel Equipment Co., Harvey, Ill., has announced that the Dennis Engineering Co., 243 No. High St., Columbus, Ohio, is now representing it in the sale of its complete pulverized coal systems.

The Leslie Co., Lyndhurst, N. J. announces that C. W. Sullivan, 621 Washington Boulevard, Chicago, Ill., is direct factory representative for sale of Leslie pressure regulators in the Chicago district, in place of O. C. Keckley Co.

The Whiting Corp. has appointed J. F. Shouse & Co., 1197 Starks Building, Louisville, Ky., as Sales Representatives for the complete Whiting line in the State of Kentucky and the southern part of Indiana.

The Dampney Company of America, Hyde Park, Boston, Mass., announces that the sales of its Apexior protective coatings for power plant equipment will be handled on the Pacific Coast by C. C. Moore & Co., San Francisco, Los Angeles, Portland, Seattle, Phœnix and Salt Lake City.

The Homestead Valve Manufacturing Co. has appointed M. S. Maleson, 442 Rockefeller Bldg., Cleveland, as exclusive sales representative in the Cleveland territory, which includes a large section of northern Ohio. Fred W. Layman, who was formerly in charge of the Cleveland District sales, is now covering the far western states in behalf of the company.

The Congress Oil Co. has been organized, with general sales offices at 396 Broadway, New York, and compounding and blending plant at Rahway, by L. Cuervo Munis, and A. L. Nugey, 37 New Church Street. Robert R. Stephens, formerly with the Gulf Refining Co., has been engaged to head the plant operations in the capacity of general manager. The company will manufacture and distribute lubricants for universal purposes.

The Foos Gas Engine Co., Springfield, Ohio, has announced, following a meeting of the board of directors, that the name of the company is now The Foos Engine Co., and that J. F. Baker and M. E. Baker have been elected president and secretary-treasurer, respectively. The program of the company includes the establishment of a factory branch at Tulsa, Okla. Garvey & Palmer, Inc., Pacific Coast representatives, have established offices in Los Angeles, San Francisco and Seattle, for handling both marine and stationary fields.

Coming Conventions

American Institute of Electrical Engineers. F. L. Hutchinson, secretary, 33 West 39th St., New York City. Pacific Coast convention at Del Monte, Calif., Sept. 13-16.

American Society of Civil Engineers. George T. Seabury, secretary, 33 West 39th St., New York City. Annual convention at Denver, Col., July 13-15.

American Society of Heating and Ventilating Engineers. Thirty-third annual convention at Greenbrier Hotel, White Sulphur Springs, W. Va., June 28-30.

American Society of Mechanical Engineers. Calvin W. Rice, secretary, 33 West 39th St., New York City. Seattle, Wash. Section, Aug. 29-31.

National Association of Practical Refrigerating Engineers. Eighteenth annual convention and educational exhibition in Civic Convention Hall and headquarters Hotel Whitcomb, San Francisco, Calif., Nov. 29 to Dec. 2. H. Fox, 5707 W. Lake St., Chicago, Ill.

National Association of Stationary Engineers—Annual convention at Ambassador Hotel, Los Angeles, Calif., Aug. 22-27. Wisconsin convention at Racine, July 19-22, secretary R. L. Scott, 410 Congress St., Eau Claire, Wis.

Universal Craftsmen Council of Engineers. Thomas H. Jones, secretary, 33 Linden Ave., Cherrydale, Va. Annual convention at Buffalo, N. Y. Aug. 2-6.

Trade Catalogs

Conoidal Ventilating Fans.—The Buffalo Forge Co. has issued Catalog No. 422 on the duplex and turbo conoidal ventilating fans manufactured by the company. There are many pictures and graphs illustrating the text.

Chemistry of Water Treatment—This educational bulletin published by the

Fuel Prices

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run except Pittsburgh gas slack:

Bituminous Net Tons	Market Quoting	June 20 1927
Pool 1	New York	$2.50@$2.75
Smokeless	Boston	1.77
Clearfield	Boston	1.65@ 1.85
Somerset	Boston	1.75@ 1.95
Kanawha	Columbus	1.35@ 1.50
Hocking	Columbus	1.75@ 1.90
Pittsburgh	Pittsburgh	1.90@ 2.10
Pittsburgh gas slack	Pittsburgh	1.40@ 1.50
Franklin, Ill.	Chicago	.....
Central, Ill.	Chicago	.....
Ind. 4th Vein	Chicago	.....
West Ky.	Louisville	1.35@ 1.60
S. E. Ky.	Louisville	1.40@ 1.75
Big Seam	Birmingham	1.50@ 1.90
Anthracite Gross Tons		
Buckwheat No. 1.	New York	2.25@ 3.00
Buckwheat No. 1.	Philadelphia	2.50@ 3.00
Birdseye	New York	1.30@ 1.50

FUEL OIL

New York—June 23, light oil, tank-car lots; 28@34 deg. Baumé, 5¾c. per gal.; 36@40 deg., 5½c. per gal. f.o.b. Bayonne, N. J.

St. Louis—June 15, tank-car lots, f.o.b. St. Louis; 24@26 deg., $1.65 per bbl.; 26@28 deg., $1.70 per bbl.; 28@30 deg., $1.75 per bbl.; 30@32 deg., $1.80 per bbl.; 32@36 deg., gas oil, 4½c. per gal.; 38@40 deg., 5½c. per gal.

Pittsburgh — June 14, f.o.b. local refinery; 30@34 deg., fuel oil, 6c. per gal.; 36@40 deg., fuel oil, 6¼c. per gal.

Philadelphia—June 15, 27@30 deg., $2.20½@$2.26½ per bbl.; 13@19 deg., $1.75@$1.81 per bbl.

Cincinnati — June 21, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 6½c. per gal.; 26@30 deg., 6⅝c. per gal.; 30@32 deg., 7c. per gal.

Chicago—June 11, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 92c. per bbl.; 24@26 deg., 97½c. per bbl.; 26@30 deg., $1.00; 30@32 deg., $1.10.

Boston—June 20, tank-car lots, f.o.b. 12@14 deg. Baumé, 4¼c. per gal.; 28@32 deg., 5.85c. per gal.

Dallas—June 18, f.o.b. local refinery, 26@30 deg., $1.40 per bbl.

International Filter Co., 333 West 25th Place, Chicago, Ill., explains to one unacquainted with chemical terms and symbols what happens when water is treated to remove scale-forming solids. The reactions taking place when the usual water-treating chemicals are added to water are graphically illustrated by simple pictures that make the understanding of the elements of water treatment easy. The water treatments illustrated are lime, soda ash, zeolite.

Boiler Meters—The Bailey Meter Co., Cleveland, Ohio, has issued a new bulletin No. 43A, giving performance data concerning the Bailey boiler meter which records steam flow, air flow, flue-gas temperature and rate of coal feed. This bulletin tells of numerous instances where large savings have been effected by the use of boiler meters in industrial plants, as well as central stations. Chart records have been reproduced in color to show the kind of boiler operations obtained before and after the installation of the steam-flow air-flow meter. This information, together with test data and cost figures showing the actual saving in fuel consumption, labor and additional boiler units, will prove of value to power-plant engineers.

Reducing Valves—Schutte & Koerting Co., Philadelphia, Pa., have issued a new circular describing a combined electric and diaphragm controlling mechanism for motor-operated reducing valves. This system can be utilized for installations where steam is extracted for process work, or for power plants where equipment designed for moderate pressures can be supplied with steam from mains carrying steam at pressures much too high for the old equipment.

Use of Powdered Coal—The General Gas & Electric Corp. has just issued a 36-page illustrated booklet in which the use of powdered coal in the operation of its electric power stations is prominently featured. It is one of the first booklets to be issued by a large power corporation treating so extensively on this subject. In the book is pictured in colors a half-section drawing of the Middletown station, near Harrisburg, Pa., showing the delivery and pulverizing of coal, producing of steam and generating and distributing of power. Properties of the various subsidiary companies are illustrated. There are pictures also of important industries which are large power users on the Pennsylvania-New Jersey, New York-Pennsylvania, North Carolina, South Carolina and Florida Power Systems. The text reviews the operations of the General Gas & Electric Corp. properties, which serve nearly 250,000 customers in 813 cities and towns. Operating revenues of these properties amounted to $24,093,376 in 1926. The issue of the book is for 15,000 copies, which are being mailed to stockholders.

Manufacturing with a "Stable-Arc" Welder is the title of a 36-page booklet just issued by the Lincoln Electric Co., Cleveland, Ohio. The theory of the use of arc welding in production manufacturing is outlined briefly, and striking illustrations are reproduced showing recent applications of the arc welding process.

The first part of the book is devoted to the replacing of iron castings by standard rolled steel sections joined by arc welding. One section is devoted to arc welding in the toolroom. Jigs, fixtures, punches, dies and strippers are illustrated which were made by arc welding at a great saving in weight and cost. There are numerous products illustrated where severe vibration must be guarded against and where manufacturers have been won over to arc welding after comprehensive tests.

New Plant Construction

Calif., San Francisco—F. E. Morgan, et al, c/o Walker & Eisen, Great Republic Bldg., Los Angeles, Archts., plans the construction of a 21 story theatre and office building at Sutter and Powell Sts. Estimated cost $3,500,000.

Conn., New London—Atlantic Coast Fisheries Corp., c/o Bilderbeck & Langdon, 159 State St., Archts., awarded contract for the construction of a refrigeration plant to A. Jackson & Co., Groton.

D. C., Washington — Dept. of Public Buildings & Public Parks, awarded contract for the construction of a boiler house at 19th and B Sts., to Concrete Oil Tank Co. Estimated cost $18,888.

Ga., Lakeland—City plans the construction of a hydro-electric plant and dam 16 ft. high on Lake Irma. Estimated cost $55,000.

Ga., Atlanta—City, W. Z. Smith, Supt. of Water, City Hall, will soon receive bids for extensions and improvements to waterworks including pumping plant and power house, etc. Estimated cost $50,000. J. N. Eley, Atlanta Trust Bldg., is engineer.

Ga., Savannah—C. F. Fulton Real Estate Co., Citizens Trust Bldg., is having plans prepared for the construction of a 6 story office building including heating plant. Estimated cost $500,000. Wallin & Comer, Realty Bldg., are architects.

Ga., Waycross — The Waycross Ice & Cold Storage Co. plans the construction of an ice and cold storage plant. Estimated cost including equipment $35,000.

Ill., Chicago—S. C. Finck, 35 South Dearborn St., Archt., will soon receive bids for the construction of a 12 story apartment at Sheridan Rd. and Glenlake Ave., for M. S. Willens, 160 North La Salle St. Estimated cost $2,000,000.

Ind., Indianapolis—Indianapolis Power & Light Co., N. A. Perry, Pres., plans the construction of a new power plant, also improvements to transmission lines recently destroyed by tornado. Estimated cost $2,500,000.

Ia., Massena—City will soon award contract for waterworks improvements including pump house, one 38 g.p.m. duplex pump and motor, 210 ft. head, one shallow well hand pump, 38,000 gal. tank on 55 ft. tower, etc. W. E. Buell & Co., 205 Davidson Bldg., Sioux City, are engineers.

La., New Orleans—The Engineering Sales Co., Inc., 640 South Peters St., is designing a power plant and factory to be constructed here. The plant will consist of a 250 hp. boiler and 200 kw. generating unit, etc. Estimated cost $200,000. Owner's name withheld.

Md., Loch Raven — Maryland Training School for Boys, will soon award contract for the construction of a power house.

Mass., Boston—Hospital Dept., J. P. Manning, is having plans prepared for the construction of a group of hospital buildings on Harrison Ave., also had revised plans prepared for addition to boiler house on Albany St. Estimated total cost $2,084,000.

Mass., Boston—Woodland Hospital, E. E. Kelsey, Pres., Woodland St., will receive bids after July 1 for the construction of a 5 story hospital, nurses' home and power plant on Beacon St. Estimated cost $1,500,000. Densmore, LeClear & Robbins, Park Sq. Bldg., are architects.

Mich., Detroit—Harper Hospital, John R. St., awarded contract for the construction of an 8 story addition to hospital on Brush Blvd., to Bryant & Detwiler Co., 2236 Dime Bank Bldg. Estimated cost $2,000,000. Steam heating and ventilation systems, boilers, elevators, etc., will be installed.

Mich., Flint—Flint Hotel Co., awarded contract for the construction of a 6 story hotel at Detroit and Third Sts., to C. S. Barry, 2631 Woodward Ave., Detroit. Estimated cost $500,000. Steam heating system, boilers, elevators, etc., will be installed.

Mich., Flint — Patterson Building Co., Harrison and Third Sts., is having plans prepared for the construction of a 14 story hotel including steam heating and ventilation systems boilers, elevators, etc., on Harrison St. Estimated cost $900,000. W. H. Maurer, Cleveland, O., is architect.

Mich., Saginaw—City, P. Sager, Comr. of Light, Water and Sewers, will soon award contract for waterworks improvements including water purification plant, pumping station, engine room, etc. H. H. Eymer, City Hall, is engineer.

Minn., Minneapolis—W. B. Foshay Co., 9th St. and 2nd Ave., awarded contract for the construction of a 26 story office building on 9th St. at Marquette and 2nd Aves., to M. Schumacher, 39 Dell Pl. Estimated cost $2,500,000. Steam heating system, etc., will be installed.

Mo., Fayette—Bd. of Trustees, Central Howard Payne College, plans the construction of a central power house. Estimated cost $100,000.

Nebraska-Wyoming — Bureau of Reclamation, Dept. of Interior, Washington, D. C., will receive bids until July 26 for the construction of second unit of Guernsey power plant, North Platte project, including a 3,000 kva. vertical hydro-electric unit together with switchboard, transformers, switching equipment, etc., here.

Neb., Omaha — St. Josephs Hospital, awarded contract for the construction of a 4 story hospital at 10th and Castellar Sts., to Peter Kiewits Sons, Omaha National Bank Bldg. Estimated cost $500,000.

N. H., Claremont—Sullivan Machinery Co., c/o C. T. Main, Inc., 201 Devonshire St., Boston, Mass., Engr., is receiving bids for the construction of a dam and power house, etc.

N. J., Bayonne—Jewish Hospital Association, 2852 Hudson Blvd., receiving competitive sketches for a 4 story hospital at Boulevard and 49th St. Estimated cost $2,000,000.

N. J., New Brunswick—New Brunswick Natatorium Co., 270 Handy Ave., is having plans prepared for the construction of an ice skating rink on Lexington Ave. Estimated cost $40,000. Private plans.

N. J., Newark—Broad Park Realty Co., 972 Broad St., awarded contract for the construction of a 4 story theatre, office and stores building, to Arenberg & Fried Co., 21 East 40th St., New York, N. Y. Estimated cost $2,000,000.

N. Y., Albany—Standard Building Corp., 44 West 18th St., New York, awarded contract for the construction of a 13 story office building at State and Howard Sts., here, to G. Richard Davis & Co., Inc., 12 East 41st St., New York. Estimated cost $1,500,000. Steam heating, refrigeration

and ventilation systems, elevators, etc., will be installed.

N. Y., New York—Chanin Construction Co., 285 Madison Ave., will build a 52 story theatre and office building including steam heating and ventilation systems, boilers, pumps, elevators, etc., at 41st to 42nd Sts. and Lexington Ave. Estimated cost $12,000,000. Sloan & Robertson, 420 Lexington Ave., are architects. Work will be done by separate contracts.

N. Y., New York—Dee Realty Corp., 358 5th Ave., awarded contract for the construction of a 35 story bank and office building at 519-521 5th Ave. to G. Richard Davis & Co., Inc., 12 East 41st St. Estimated cost $2,000,000. Steam heating and ventilation systems, boilers, pumps, elevators, etc., will be installed.

N. Y., New York—Eljac Realty Corp., 1440 Broadway, will build an 18 story loft building including steam heating and ventilation systems, elevators, etc., at 35th St. and 9th Ave. Estimated cost $1,500,000. C. J. Storm, 1440 Broadway, is architect. Work will be done by separate contracts.

N. Y., New York—The Williamsbridge Hygenia Ice Co., 916 East 228th St., plans the construction of an ice plant. Estimated cost $40,000.

N. C., Burlington—National Dye Works, awarded contract for the construction of a boiler house to Potter & Shackleford, Greenville, S. C.

O., Columbus — Schmitter Bros., 1738 Myrtle Ave., will build a garage including power house on Myrtle Ave. Estimated cost $35,000. Private plans. Work will be done by separate contracts.

Okla., Sayre—City, H. O. Brown, Clk., will soon award contract for waterworks improvements including two wells, pumps, motors, etc. Estimated cost $53,000. E. W. Gantt, 1116 West Main St., Oklahoma City, is engineer.

Pa., Lewistown—Levy & Berger, 375 Fulton St., Brooklyn, N. Y., Archts., are preparing plans for the construction of a power house here. Estimated cost $150,000. Owner's name withheld.

Pa., Philadelphia — Manufacturers Exchange Realty Co., c/o W. Goldstein, 1415 Locust St., plans the construction of a sales display and manufacturing building at 232-248 North 11th St. Estimated cost $1,000,000. L. B. Rothschild, 216 South Broad St., is architect.

Texas—West Texas Utilities Co., Abilene, is having plans prepared for the construction of a steam turbine generating plant, 20 mi. from San Angelo, also transmission line from San Angelo to Crane County, 150 mi. Estimated cost $2,000,000. Private plans. Machinery and equipment will be required.

Tex., Abilene — Banner Creamery Co., O. D. Dillingham, Mgr., will soon award contract for the construction of a creamery plant, also 50 ton ice plant. Estimated cost including equipment $100,000. Private plans.

Tex., Cuero — Texas Central Power & Light Co., Frost Bldg., San Antonio, plans the construction of a power plant and dam, 35 x 300 ft. long on the Guadalupe River near here. Estimated cost $1,000,000. Private plans.

Tex., Dallas — Southwestern Bell Telephone Co., 11th and Pine Sts., St. Louis, Mo., will soon receive bids on superstructure of a 16 story office building at Akard and Wood Sts. Estimated cost $2,500,000. I. R. Timlin, c/o owner, is architect. Lang & Witchell, 300 American Exchange Bldg., Dallas, Tex., associate architects. W. J. Knight & Co., Wainwright Bldg., St. Louis, Mo., engineers.

Tex., Eastland—Oil Belt Power Co., J. E. Lewis, V. Pres., plans to enlarge power plant including 15,000 kw. turbine with boilers, condensing equipment, etc., also transmission lines.

Tex., Edinburg—Pacific Fruit Express Co., c/o H. T. Whyte, 605 Commercial Bank Bldg., Houston, will soon award contract for the construction of a 100 ton ice and cold storage plant. Estimated cost $250,000. Private plans.

Tex., Harlingen—J. M. Marriott, Frost National Bank Bldg., San Antonio, Archt., will soon receive bids for the construction of an ice plant here for Texas Central Power Co., Frost National Bank Bldg., San Antonio. Estimated cost $50,000.

Tex., Laredo—Central Power & Light Co., S. M. Udden, Mgr., Frost Bldg., San Antonio, will receive bids until July 7 for waterworks improvements including filtration plant and pumping station, etc., here. Estimated cost $80,000. Alvord, Burdick & Howson, c/o owners, are engineers.

Tex., San Antonio—F. L. Thompson, c/o Grayburg Oil Co., Maverick Bldg., has acquired a site and plans the construction of an office building on Travis & North Alamo St. Estimated cost $500,000. Architect not selected.

Wis., Burlington—J. Bazal, will soon award contract for the construction of addition to creamery plant including refrigeration system, 45 hp. boilers and motors, etc. Estimated cost $40,000. Davis & Tuckwell, 377 National Ave., Milwaukee, are architects and engineers.

Ont., Ottawa — Canadian National R.R., Montreal, Que., awarded contract for steel for addition to hotel here. Estimated cost $700,000.

Ont., Toronto—Star Publishing Co., King St. E., has acquired a site and plans the construction of a 10 or 12 story newspaper and office building including steam heating system, elevators, etc. Estimated cost $800,000. Architect not selected.

Equipment Wanted

Air Compressors — Borough of Spring Lake, N. J., plans to purchase two cross compound steam 2 stage air compressors for water plant. Estimated cost $15,000.

Air Compressors—Dept. of Public Welfare, J. E. Harper, Dir., Ninth and Oak Sts., Columbus, O., is in the market for two steam driven air compressors for Boys Industrial School at Lancaster, O.

Boilers—Bd. of Comrs., A. M. Johnson, Auditor, Princeton, Ind., will receive bids until July 6 for two smokeless firebox tubular boilers for court house.

Engines, Motors, Controls, etc. — C. P. Heipp, Clk., West Bend, Wis., will receive bids until July 7 for pumping equipment including engines, motors, controls, etc., for proposed waterworks improvements.

Ice Plant Machinery—New York Buyers' Association, Yeakum Bend, San Antonio, Tex., is in the market for machinery for proposed 25 ton ice plant. Estimated cost $50,000.

Pump and Conduit Line—Common Council, Albany, N. Y., plans the installation of a 10,000,000 gal. electric pump, also new conduit line for water supply. Estimated cost $300,000.

Pump and Motor—J. C. Williams, Clk., Hanford, Calif., is receiving bids for a 150 g.p.m. centrifugal pump and motor for proposed waterworks improvements for Lacey Park.

Pumping Equipment — Carruth - Parks, Inc., Travis Bldg., San Antonio, Tex., will be in the market for pumping equipment, etc., for proposed waterworks and distribution system on North Side. Estimated cost $25,000.

Pumping Equipment—City of Frankston, Tex., will be in the market for pumping equipment for proposed waterworks improvements. Estimated cost $15,000.

Pumping Equipment—City of Glen Rose, Tex., will be in the market for pumping equipment, etc., for proposed waterworks improvements. Estimated cost $35,000.

Pumping Equipment, Etc.—City of Rock Springs, Tex., will be in the market for pumping equipment, etc., for proposed waterworks system to replace one recently destroyed by tornado. Estimated cost $28,000.

Pumping Equipment—City of Alice, Tex., will be in the market for pumping equipment, etc., for proposed waterworks improvements. Estimated cost $18,000.

Pumping Equipment—Dept. of Streets & Sewers, Chattanooga, Tenn., will receive bids until July 10, for electrically operated pumping equipment for proposed sewage pumping station.

Pump, Engine, Air Compressor, etc.—City of Trappe, Md., will receive bids until July 11 for a pump, engine, air compressor, etc., for proposed waterworks pumping station.

Pumps, Etc.—City of Amherst, O., will receive bids until July 5 for one 200 g.p.m. centrifugal pressure pump and one 100 g.p.m. low head humus sludge pump, etc., for proposed sewage treatment plant and pumping station. Estimated cost $67,000.

Pumps—City of East Lansing, Mich., will be in the market for electrically driven centrifugal pumps for proposed sewage treatment plant and pumping station. Estimated cost $100,000.

Pumps—Dept. of Public Works, R. W. Wolfe, Comr., Chicago, Ill., will receive bids until June 30 for three steam turbine-driven centrifugal boiler feed pumps for Central Park Avenue pumping station.

Pumps, Etc.—Central Power & Light Co., S. M. Udden, Gen. Supt., Frost Bldg., San Antonio, Tex., will receive bids until July 7 for motor driven centrifugal pumps, etc., for proposed pumping station and filtration plant.

Refrigeration Equipment — Bureau of Yards & Docks, Navy Dept., Washington, D. C., will receive bids until July 6 for refrigeration equipment for cold storage plant at Naval Operating Base, Hampton Roads, Va.

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Volume 65 June 28, 1927 Number 26

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BOILERS AND FURNACES

Breaking in a New Fireman 996
By PETER J. LYONS.

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ELECTRIC POWER FROM A CENTRAL PLANT for drilling and pumping oil wells was in this field considered preferable to the use of steam or gas in individual plants. Cheap fuel in the form of wet gas with the casing-head gasoline extracted, prohibited expensive refinements. Steam is bled to heat the feed water and combustion air is preheated in hollow furnace walls.

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IN ADDITION TO TESTING WORK for the Naval Bureau this station also tests apparatus submitted by manufacturers to determine actual performance and to ascertain its suitability for use in the navy or other government service.

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Publishers of
Engineering News-Record **American Machinist**
Power **Chemical and Metallurgical Engineering**
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Bus Transportation **Electric Railway Journal**
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(Published in San Francisco)
American Machinist—European Edition
(Published in London)

The annual subscription rate is $3 in the United States and Canada, Alaska, Hawaii, the Philippines, Porto Rico, Canal Zone, Cuba, Haiti, Mexico, Honduras, Nicaragua, Dominican Republic, Salvador, Panama, all South American countries except Venezuela, and Guiana and Spain. Extra foreign postage $3 (total $6, or 25 shillings). Single copy, 15 cents.

Change of Address—When change of address is ordered the new and the old address must be given. Notice must be received at least ten days before the change takes place.

Published weekly. Entered as Second-Class Matter, Dec. 20, 1910, at the Post Office at New York, N. Y., under the Act of March 3, 1879. Printed in U. S. A. Established 1880.

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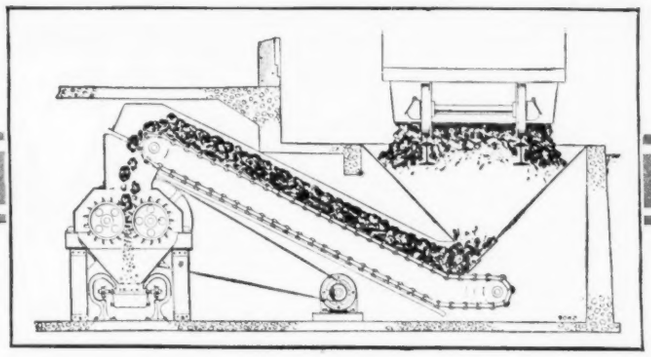
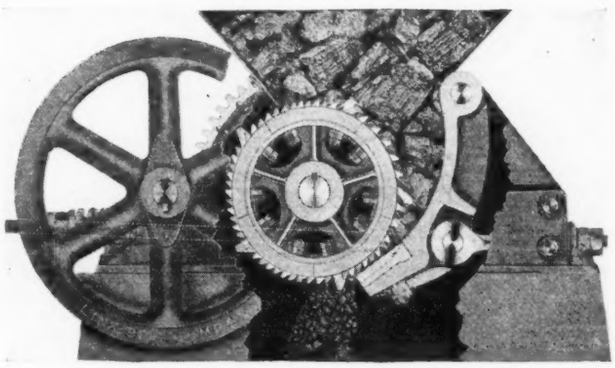
"I do look over and read the advertisements in POWER."

From the chief engineer of a candy plant known country-wide as a model of efficiency and economy.

Power plant efficiency and economy is simpler when POWER'S ads guide purchases.



Better Fires and More Fuel Value From Coal Crushed in a Link-Belt Crusher



Cross section of a Link-Belt Single Roll Crusher built in sizes to suit.

A UNIFORMLY crushed coal is not only desirable but necessary if its full value is obtained from the fires.

The construction of Link-Belt Crushers assures an evenly sized product.

Built in single—two roll and four roll types—you can secure assistance in proper selection and application, without obligation, from the nearest Link-Belt Engineer. Crusher Book No. 802 upon request.

Link-Belt builds complete equipment for handling coal and ashes. No work too small—or too large—to interest us.

Link-Belt Products

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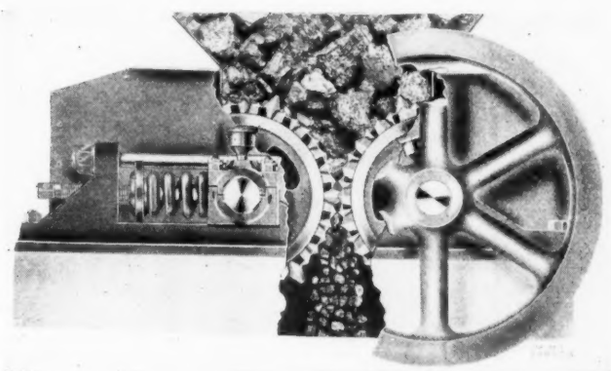
Power Hoes	Chains, Wheels, Buckets
Weigh Larries	Transmission Machinery
Coal Bunkers	Send for catalogs.



A cross section of the Link-Belt Two Roll Crusher built with a by-pass adjustment which permits coal to flow through without crushing when desired.

3146

LINK-BELT COMPANY

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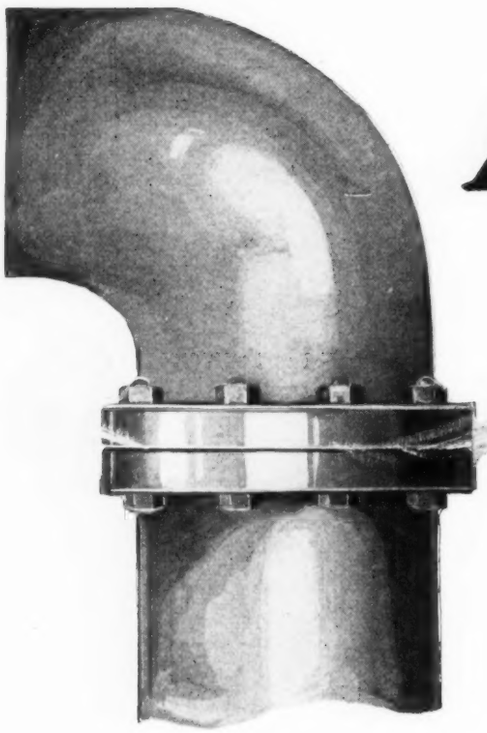

A joint should be seen and not heard

Hush the hiss of leaking pipe joints by packing with Jenarco. You can then feel sure that the packing is in the joint to stay— that there will be no cracking, crumbling or squeezing-out.

Jenarco is a red vulcanized rubber packing, extremely tough and strong, which is recommended for hot and cold water and saturated steam. It is supplied in sheet form or in ready cut gaskets.

Jenarco is one of several brands of Jenkins Packings which include *Jenkins* 96, a black rubber packing which is vulcanized in the joint by the heat and the pressure, and *Compressed Asbestos Jointing* for high pressure superheated steam. All brands are available in gasket form.

Send for a copy of the Jenkins Packing or Gasket folder.

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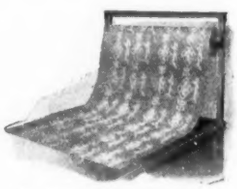
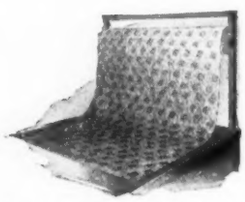
Jenkins Bros

Jenarco Sheet Packing



Jenkins '96 Sheet Packing



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Jenkins Packing

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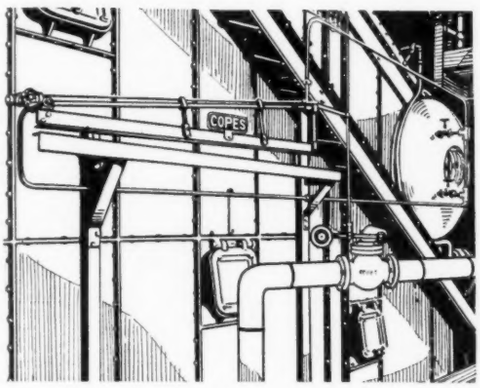
Control Valve movement that is *geared* to water level movement



It takes less than one second for changes in boiler water level to effect the expansion or contraction of the thermostatic tube of the COPES Feed Water Regulator. With the stress on the levers in the same direction at all times, this change in water level causes an immediate change in the control valve opening.

Any lag in operation is impossible because of the powerful actuating force that is constantly available. There is no time loss due to inertia or lost motion in the moving parts.

The accompanying charts show that the COPES Regulator is just as accurate as it is instant. The COPES control valve is definitely geared to boiler water level— an exact valve opening for given furnace and load conditions.

78% of the feed water regulators selected for all principal central stations completed in 1926 or now under construction were COPES as against 22% of all other makes combined. In industrial plants, too, a relatively high percentage choose COPES Regulators.

These Charts show the COPES' accuracy and quick response

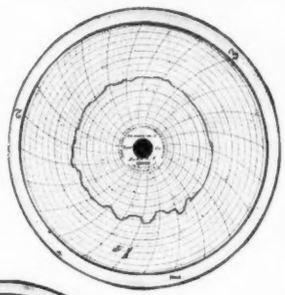


Chart No. 1 shows the movement of the COPES Regulator valve. The pen moved toward the center of the chart as the valve opened.

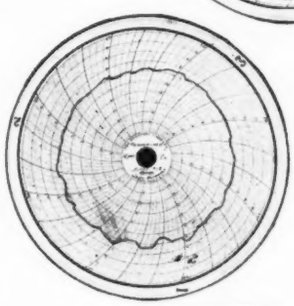


Chart No. 2 shows the movement of the water level with the pen moving toward the center of the chart as the water level lowered.

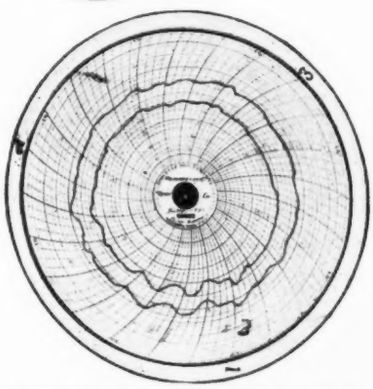
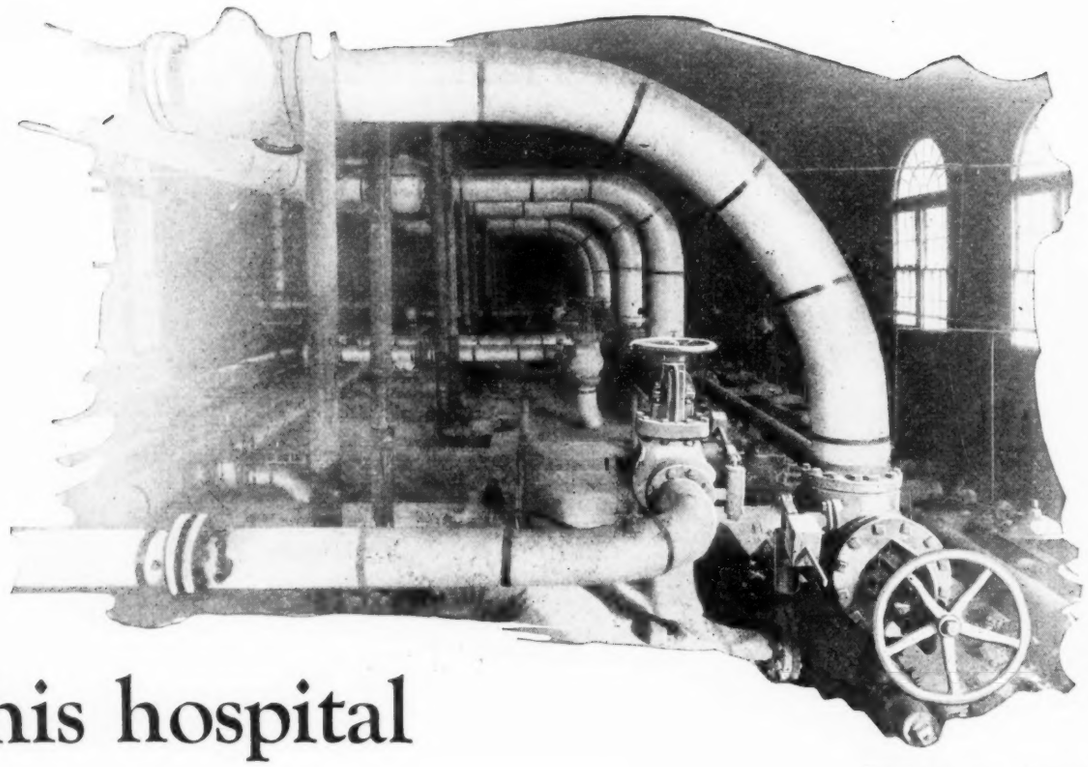


Chart No. 3 is a composite of No. 1 and No. 2—two exposures on the same plate. Note how closely the valve movement follows the water level. This shows how accuracy and how instantly the COPES Regulator responds to every change in furnace and load conditions.

***Booklet "A," sent on request, tells all about the* COPES**

NORTHERN EQUIPMENT CO., 190 Grove Drive, Erie, Pa.
Branch Plants in Canada, England, France, Germany, Austria and Italy



Elliott-Lagonda Automatic Valves at the State Hospital, Allentown, Pa.

This hospital believes in *"Safety first"*

Specializing in cure, they know that prevention is better, at the State Hospital, Allentown, Pa. So they put a sure guard against big trouble in the power plant by equipping each boiler with two Elliott-Lagonda Valves of the Double-Automatic type.

These valves are in complete control. Unruly steam cannot get past them, either way. Reversal of steam flow or excessive velocity closes the valve instantly and surely, preventing serious results. Steam cannot be turned into a boiler in which a man may be working, for the valve cannot be opened unless boiler pressure is equal to or slightly in excess of header pressure. A complete protection all around.

Your plant deserves the security afforded by Elliott-Lagonda Automatic Valves.

ELLIOTT LAGONDA AUTOMATIC VALVES

Also made in non-return type, with internal or external dashpot. For pressures up to 450 lbs. and temperatures of 800 degrees F.

Elliott Power Equipment includes prime movers, generators and electrical machinery, condensers, deaerators, centrifugal blowers, and accessory equipment.

ELLIOTT COMPANY
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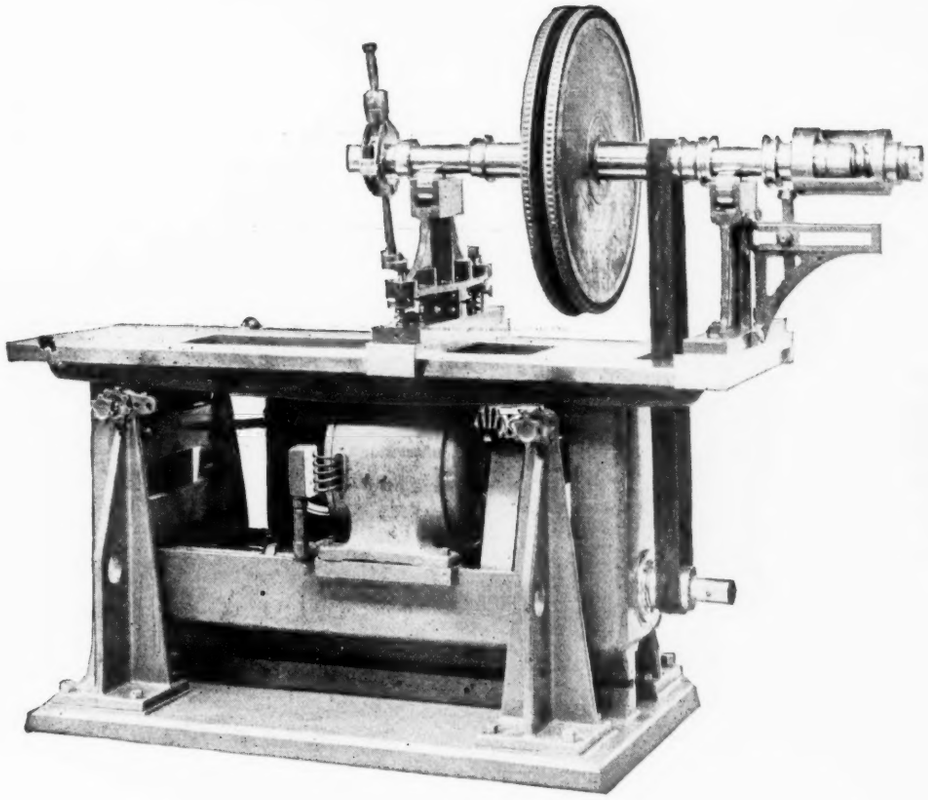
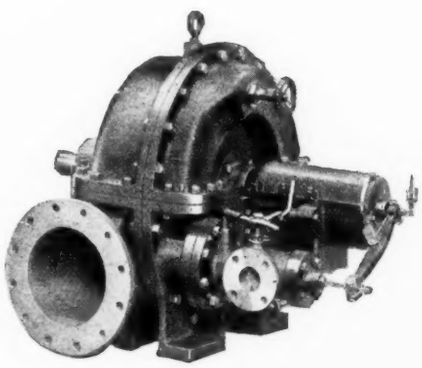
S-1105

This machine balances vibration out of turbine rotors



Elliott Turbine rotors are accurately balanced dynamically on the specially designed machine illustrated above. This machine is extremely sensitive and with it an accurately true balance is obtained.



Elliott-Kerr Turbine for mechanical drive

A balanced rotor running in heavy, cool bearings and supported by all-around rugged construction in every part of the turbine makes certain the smooth and reliable operation of Elliott Mechanical Drive Turbines.

Elliott Power Equipment includes steam turbines, engines, generators, and electrical machinery, condensers, deaerators, centrifugal blowers, and accessory equipment.

H-497a

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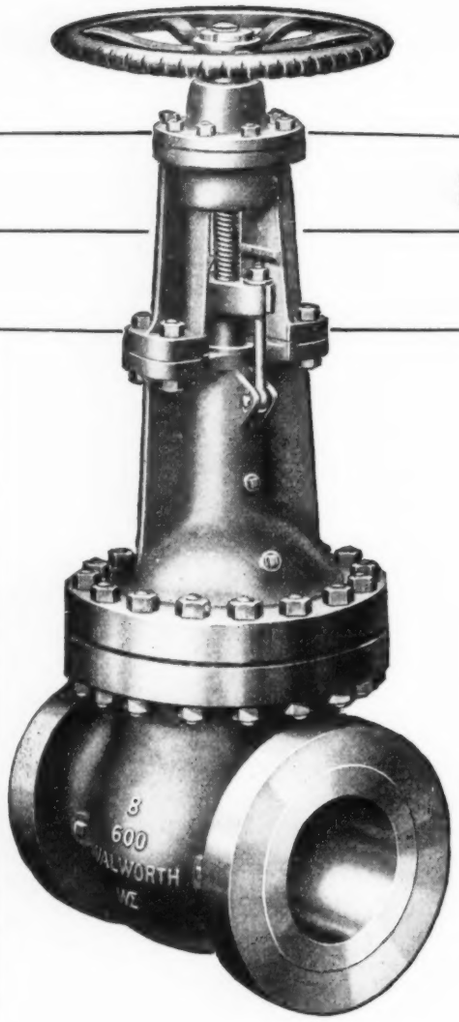

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SIGMALLOY 351 TRIM

"AA" VALVES
Now available in
Series 150 to 1350

SIGMALLOY
in the parts that stand the racket

The working parts of this Class "AA" Walworth Sigma Steel Gate Valve with Sigmalloy No. 351 trim, are of a material peculiarly adapted to withstand hard service on high-pressure, high-temperature lines. Sigmalloy is the name registered by Walworth in the United States for valve trim and other materials of a character especially suited to resist corrosion under severe conditions of heat and pressure.

This heart of Sigmalloy is contained within a body of Walworth Sigma Steel, made under an entirely new and improved foundry technique, developed by X-ray tests. This technique results in a peculiarly homogeneous steel, free from the internal defects found in ordinary steel castings.

These valves are now available in Series 150 to 1350. We shall gladly send you full information in Bulletins 7 and 12-D.

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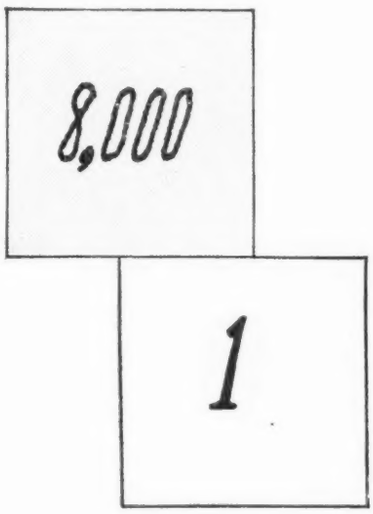
(300 gr. per gal. concentration)

Carries into the Steam Line

68,000 Pounds of Impurities

Per 1,000 Developed Boiler H. P. per Year



½ of 1%
Steam
is
1 part Water
to
8,000 parts Steam
by Volume

Here's the Reason Why the Tracyfier Is a Precision Instrument

THE Tracyfier removes *ALL* the water, leaving clean, dry steam, a big job that can be done *only* by a precisely-built instrument—as accurately constructed as a fine watch.

Write for Bulletin No. 40

ANDREWS-BRADSHAW CO.

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Industry consults C.H.Wheeler-

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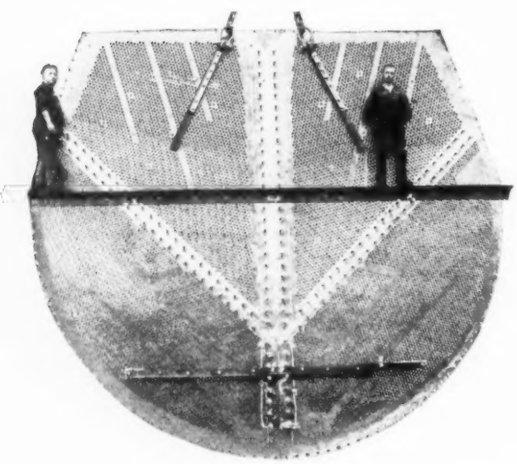
IRON MINES

Iron Mines are another of the great fundamental industries of America that have come to C. H. Wheeler, Condenser Specialists, for solution of their condenser problems.

An outstanding instance in this field is the Oliver Iron Mining Co., which conducts tremendous operation in the open pits of the Mesaba Range in Minnesota.

We studied the job as an individual, recommended and built each piece of equipment to give maximum vacuum consistent with operating conditions, with minimum cost for circulating pumping, greatest possible return of condensate heat to the boilers, free of air.



In service, the equipment has fully confirmed the care in selection and building.

Industry consults C. H. Wheeler—
and gets *expert* advice!

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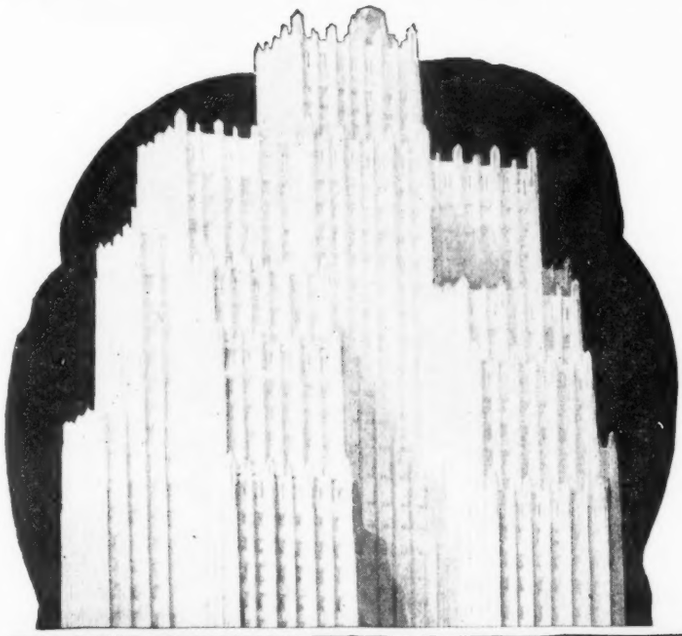
on your condenser problems



St. Louis, speaking!

The new 33-story Southwestern Bell Telephone Building is the talk of St. Louis—no wonder, for it is one of the greatest buildings in America.

The way McClave is installing stokers in the greatest buildings is the *talk of America!*

This installation in the Southwestern Bell Telephone Building consists of three McClave Class C—3 Universal Stokers under three 395 hp. vertical water tube boilers. These stokers are motor driven and run on natural draft. Either natural draft or forced draft can be used with this type of stoker. Center drive, using only one operating shaft for both pusher and kicker bars. Unusual flexibility of control results from the use of the exclusive timing device, giving various feed regulations without altering the speed of the motors. The large hoppers are fed by a mono-rail coal lorry which weighs the coal.

Consult our nearest office about your combustion problem.

Stoking Southwestern Bell

McClave

Universal Mechanical Stoker

for all grades of bituminous and lignite

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Sole Makers of McClave Grates Since 1883

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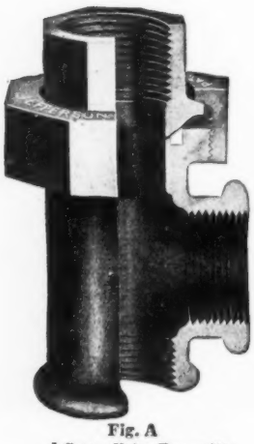


Fig. A
Jefferson Union Tee—with Union on the Run

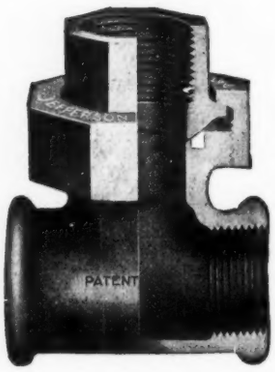


Fig. B
Jefferson Female Union Tee

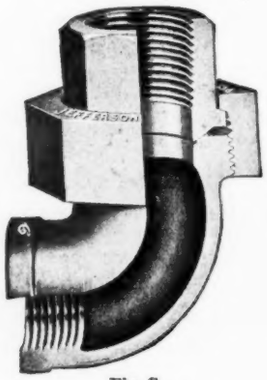


Fig. C
Jefferson Union Elbow, 90° Angle

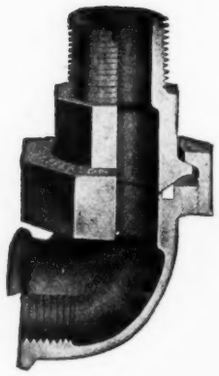


Fig. D
Jefferson Male and Female Union Elbow, 90° Angle

Jefferson Unions & Flanges

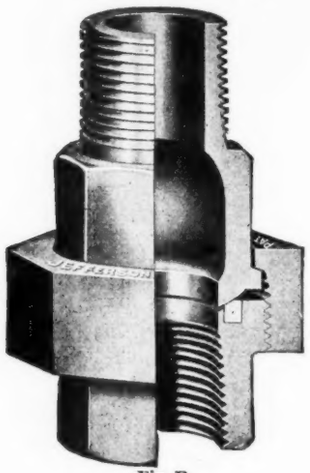


Fig. E
Jefferson Male and Female Union

A complete line of Fittings

You know the Jefferson Unions and their excellent features so popular in the engineering world.

The same excellence is embodied in Jefferson's complete line of fittings.

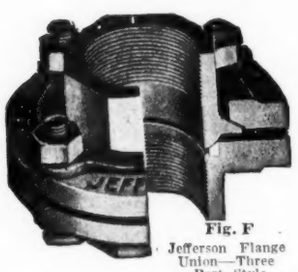


Fig. F
Jefferson Flange Union—Three Part Style

Figure "B" Jefferson Female Union Tee

takes the place of a tee, a nipple and an ordinary union, and saves three pipe joints—makes a good compact fitting—saves time and money.

Special Features

Made of Air Refined Malleable Iron.

Brass Seat Ring located in a recess away from the runway of the fitting (patented feature).

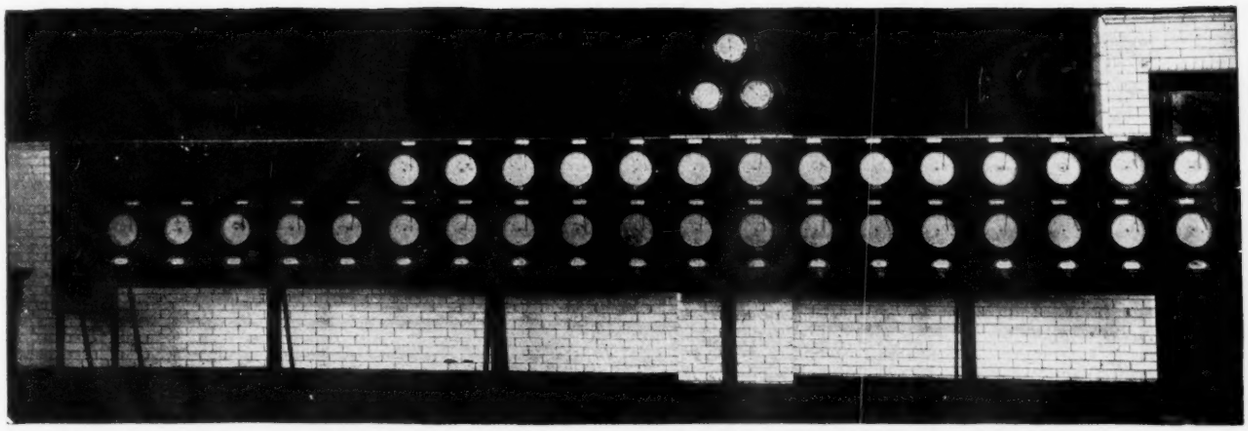
Briggs tapered pipe threads.

Large amount of play in the ball end (an especially valuable feature when pipes are not in line).

Joints ground in pairs (self-seating and absolutely tight).

JEFFERSON UNION COMPANY
Lexington, Mass., U. S. A.

JEFFERSON



Republic Recording Flow Meters and Integrators centralized on a large panel board at the Philadelphia & Reading Railway Company, Reading, Penna.

After Four Years of Service

at the

Philadelphia & Reading Railway Shops

In 1922 the Reading Company, operating the Reading Lines, recognized the need of Steam Flow Meters in their shops and after a thorough investigation 33 Republic Flow Meters were installed in the boiler room of their shops at Reading, Penna.

In August, 1926, four years after the installation, a neutral engineering company made a survey of the results which had been obtained.

Mr. W. L. Rice, Superintendent of Shops for the Reading Lines states, "Prior to installing meters the load on each boiler could not be determined. This made it unsafe to operate at the high ratings now possible. Thus the flow meters have increased the capacity of the boiler plant."

This survey is a complete history of the installation giving in detail such facts as:

1. Power Plant Equipment
2. Flow Meter Equipment
3. Effect on Boiler Operation
4. Effect on Stationary Engine Operation
5. Results on Steam Distribution Lines
6. Benefits to Cost Department
7. Performance of Republic Flow Meters, etc.

Write for Survey made at Reading Railway Shops

REPUBLIC FLOW METERS COMPANY

EXECUTIVE OFFICES AND PLANT: 2222 DIVERSEY PARKWAY, CHICAGO, ILL.

DOMINION FLOW METERS CO.
Toronto and Montreal,
Canada

Branch Offices in 25 Principal Cities

ELECTROFLO METERS CO.
Park Royal, London, N.W. 10,
England

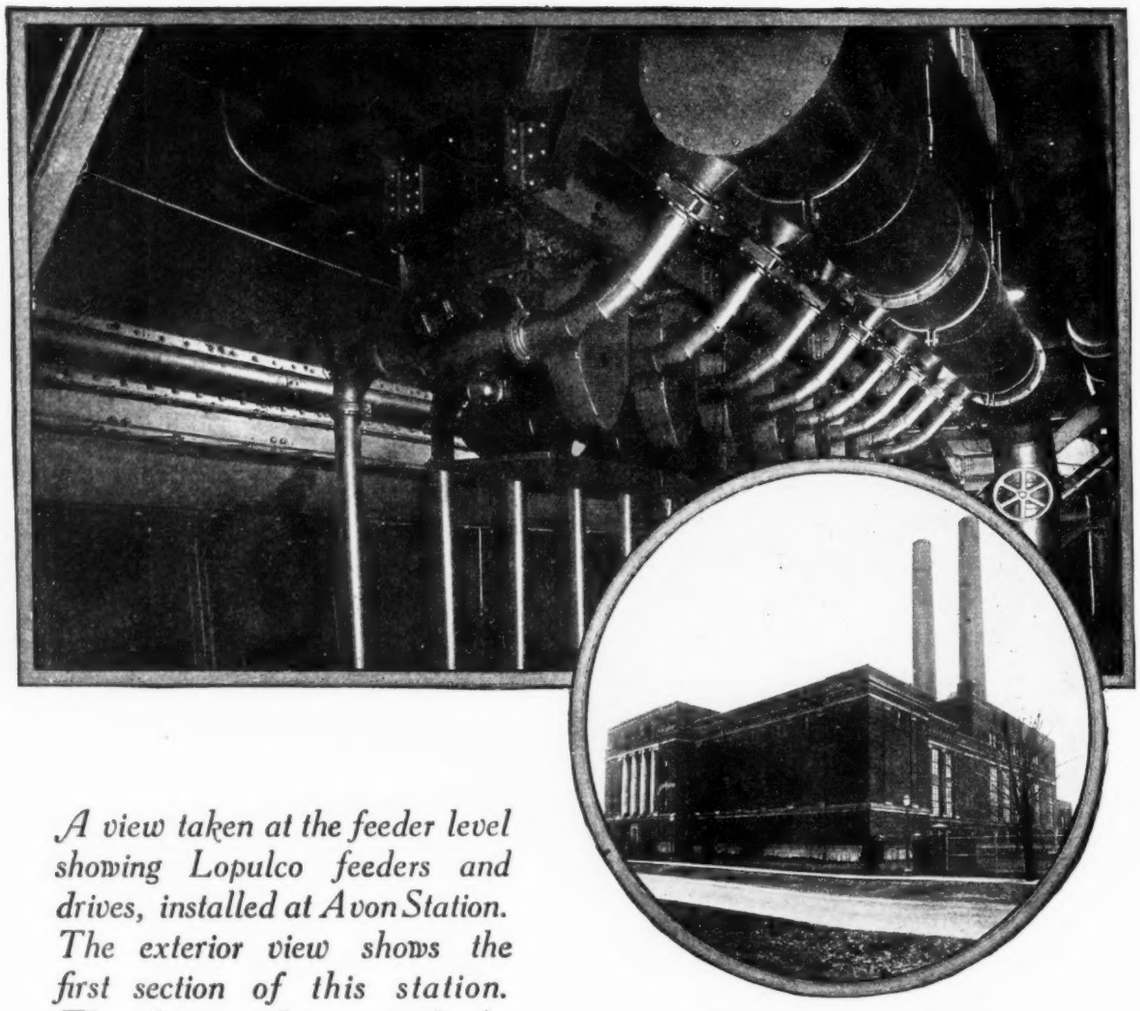
REPUBLIC FLOW METERS

CO_2 Recorders.
Draft Instruments
Coal Meters
Recording Pyrometers
Indicating Pyrometers

Republic System

Boiler Meters
Meters, Water and Gas
Meters, Air and Steam
Liquid Level Indicators
and Recorders

Tremendous Concentr



A view taken at the feeder level showing Lopulco feeders and drives, installed at Avon Station. The exterior view shows the first section of this station. The ultimate plans provide for three times the present capacity,

This company's three stations, Avon, Lakeshore and 20th St. are all Lopulco equipped.

Combustion

International Combustion Building

A SUBSIDIARY OF INTERNATIONAL

ation of Steam Power

345,000 Lbs. of Steam Per Hour From One Unit at Avon Station Cleveland Electric Illuminating Company

THE Cleveland Electric Illuminating Company first installed Lopulco Pulverized Fuel Systems to serve four 3000 horse power boilers at the Lakeshore Station. This company next installed Lopulco Systems at the 20th Street Heating Plant where three 1500 horse power boilers are equipped.

When the new Avon Station ★ was built, four 3000 horse power boilers were installed. These units were also Lopulco equipped.

Tremendous concentration of Steam Power is demanded in modern central stations.

Lopulco meets this demand.

★*Combustion Engineering Corporation Equipment installed at this Plant Includes—*

Lopulco Pulverized Fuel Systems
Lopulco Water Screens
Lopulco Coal Dryers
Raymond Coal Transports
Raymond Pulverizing Mills

INTERNATIONAL COMBUSTION ENGINEERING CORPORATION

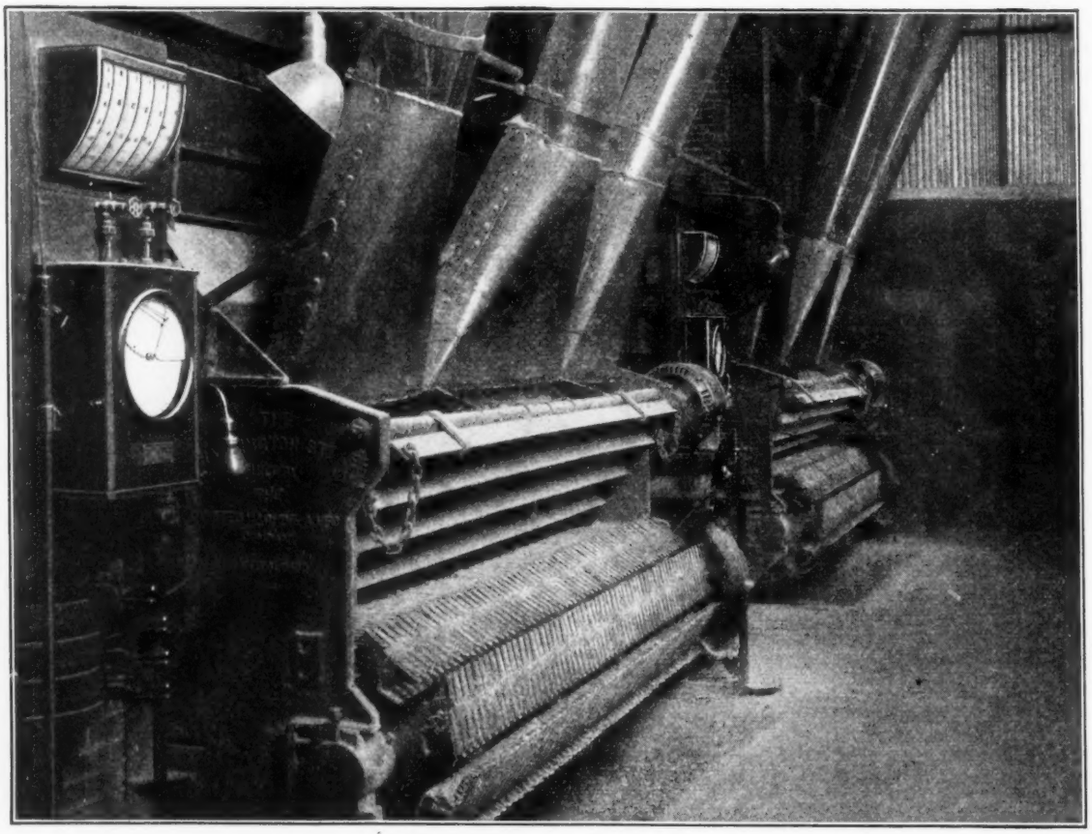
Lopulco Storage System (*Pulverized Fuel*)
Lopulco Unit System (*Pulverized Fuel*)
Raymond Pulverizing Mill
C-E Fin Furnace
C-E Air Preheater
Frederick Multiple Retort Stoker
Type E Stoker
Type K Stoker
Type H Stoker
Coxe Stoker
Green Natural Draft Stoker
Green Forced Draft Stoker
C-E Ash Conveyor
Combustion Steam Generators
Ladd Boilers
Heine Boilers

n Engineering

oration 200 Madison Ave (35th to 36th Sts) New York

L COMBUSTION ENGINEERING CORPORATION

BAILEY METERS



Increase Boiler Room Efficiency

Every power plant engineer is vitally interested in power plant efficiency and anxious to adopt ways and means of increasing the economy as well as the capacity of his plant with the least expenditure. The first step is to locate and determine the magnitude of the losses so as to be able to reduce them to a minimum and thereby improve the final results.

You can determine the fuel and stack losses as well as check the fuel, steam and water consumption by the use of Bailey Meters.

Practically all of the Central Stations and the largest power users throughout the country are controlling boiler operation by the aid of Bailey Boiler Meters and Multi-Pointer Gages.

The above installation shows a Bailey Boiler Meter for recording Steam Flow from the boiler, Air Flow used for combustion and Flue Gas Temperature on one chart. Above the recording meter is a Bailey Multi-Pointer Gage indicating Main Duct Pressure, four Compartment Pressures and Uptake Draft.

BAILEY METER COMPANY

2011 East 46th Street, Cleveland, Ohio

Bailey Meter Company, Limited, Montreal, Quebec

..and now the answer

Perhaps you noticed the above advertisement when it appeared in a recent issue of this publication. Could there be a better answer to the question it raises than the operating records of the F-M equipped plants briefly described here?

None of these plants is operated under conditions that are particularly favorable to Diesel application, and practically all kinds of plants are typified by the installations. The records are therefore representative and conclusive.

When the Diesel receives full consideration wherever power is required there will be thousands of plants like these!

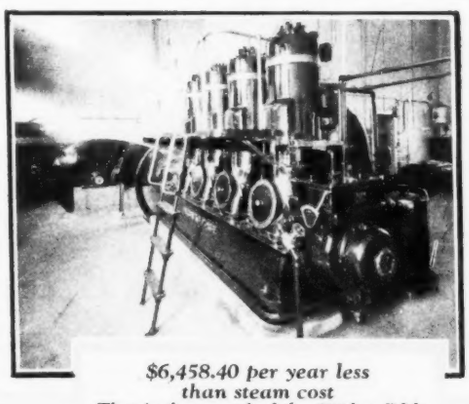
Ask for bulletin, "Economy of Diesel Power."

FAIRBANKS, MORSE & CO., *Chicago*
28 branches throughout the United States at your service

FAIRBANKS MORSE

DIESEL ENGINES

PUMPS · MOTORS · SCALES

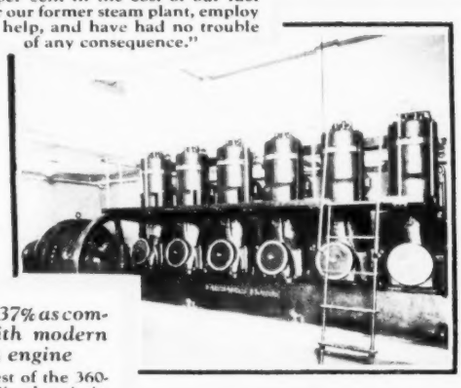


$6,458.40 per year less than steam cost

That is the record of the 200-hp. F-M Diesel which replaced a steam engine in the Shoreham Elevator owned by Osborne-McMillan Co., Minneapolis. Incidentally, the cost of operating this Diesel is 20 per cent below the F-M guaranty.

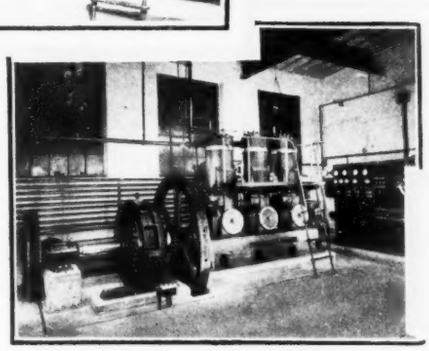
Replaces steam — saves 50%

F-M Diesels replaced steam in the power plant on Mackinac Island. The owner of this plant, F. B. Doherty, says: "We are now saving over 50 per cent in the cost of our fuel over our former steam plant, employ less help, and have had no trouble of any consequence."



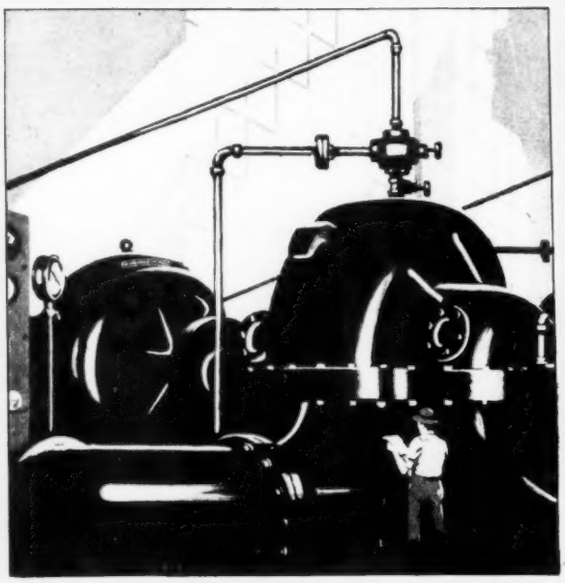
Cuts cost 37% as compared with modern steam engine

A recent test of the 360-hp. F-M Diesel unit in the municipal power and water plant of the city of Julesburg, Colo., showed that the Diesel made a net saving of $27.32 per day in comparison with a steam engine of the *most modern type.*



Far lower than steam cost

At Elgin, Ill., a 180-hp. F-M Diesel has replaced a steam engine in the plant of the Elgin Butter Tub Co. Power costs have come down to just slightly over ½ cent per kw-hr.



The illustration shows one of six 600-hp. F-M Ball-bearing Motors which drive 36-inch F-M Centrifugal Pumps delivering 300,000,000 gallons of water a day in the City of Philadelphia Torresdale Filtration Plant. These motors are probably the largest of the ball-bearing type ever built.

Why this increasing demand for *ball-bearing* motors?

STEADILY and surely the motor user is recognizing the *plus* value of a good ball-bearing motor.

This is proved by increasing sales. Also by the widespread adoption of anti-friction bearings by motor manufacturers in general. It is a natural reaction from a cycle of price buying.

The man who watches motor maintenance cost, instead of initial cost, has found that the almost negligible difference in the price of a ball-bearing motor comes back many times in service. Men who install machines costing thousands of dollars have sensed the fallacy of splitting pennies when buying the motor on which the machine depends.

In bringing the ball-bearing motor to its present favored position Fairbanks-Morse has shown the way. The experience of this organization began with the introduction of the first complete line of general purpose ball-bearing motors.

Through specialized experience Fairbanks-Morse has built a motor that appeals to the operator who wants uninterrupted service and isn't at all interested in the reasons for motor failure.

One motor is better than the F-M *sleeve-bearing* Motor; it is the F-M *ball-bearing* Motor.

FAIRBANKS, MORSE & CO., *Chicago*

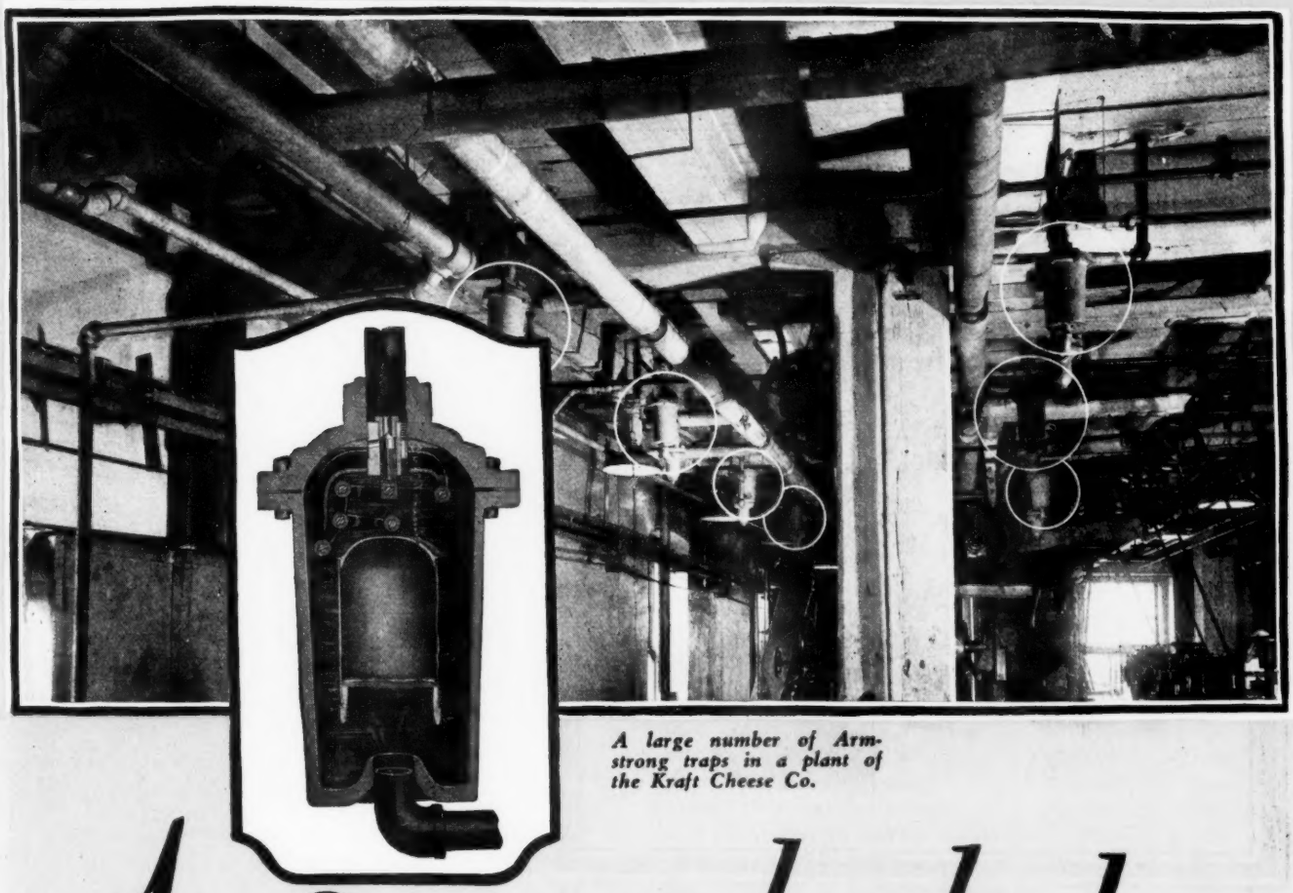
28 branches throughout the United States at your service

FAIRBANKS-MORSE

Pioneer Manufacturers of

ball bearing motors

AOA40.16



A large number of Armstrong traps in a plant of the Kraft Cheese Co.

Armstrong traps lose less heat

THE radiation of heat from a steam trap is directly proportional to its size. It becomes quite an item where many traps are used. That is where Armstrong makes one saving. It is small and very compact, due to the submerged inverted bucket and the lever arrangement. Heat is expensive—save it.

The Armstrong trap is free from valve troubles. The heat-treated, chrome steel valves do not cut, causing the trap to leak and to waste steam.

The Armstrong will not air-bind. This adds to its efficiency as there is no waste of steam in preventing this trouble.

Then, too, the up-keep expense of the Armstrong is low. Five to ten year's service with no up-keep expense is not uncommon.

With its low heat losses and its ability to take care of the condensate continuously, without attention, the Armstrong presents a high degree of efficiency.

The patented feature, the inverted submerged bucket principle, together with the lever construction are the reasons why the Armstrong trap is simple and efficient. Because of its compactness, the course of the water is such that it is always kept free of sediment, oil and sludge.

But don't take our word for it. Ask us for one to test for 90 days or so. Then send it back to us. It will cost you nothing.

ARMSTRONG MACHINE WORKS
312 Maple Street, Three Rivers, Michigan

Please ship prepaid an Armstrong trap for a 90-day test. When the test is completed the trap will be returned collect.

Name _____

Street Address _____

City and State _____

Trade _____

Name of Jobber _____

Check here if you want booklet only ☐

Armstrong Steam Trap

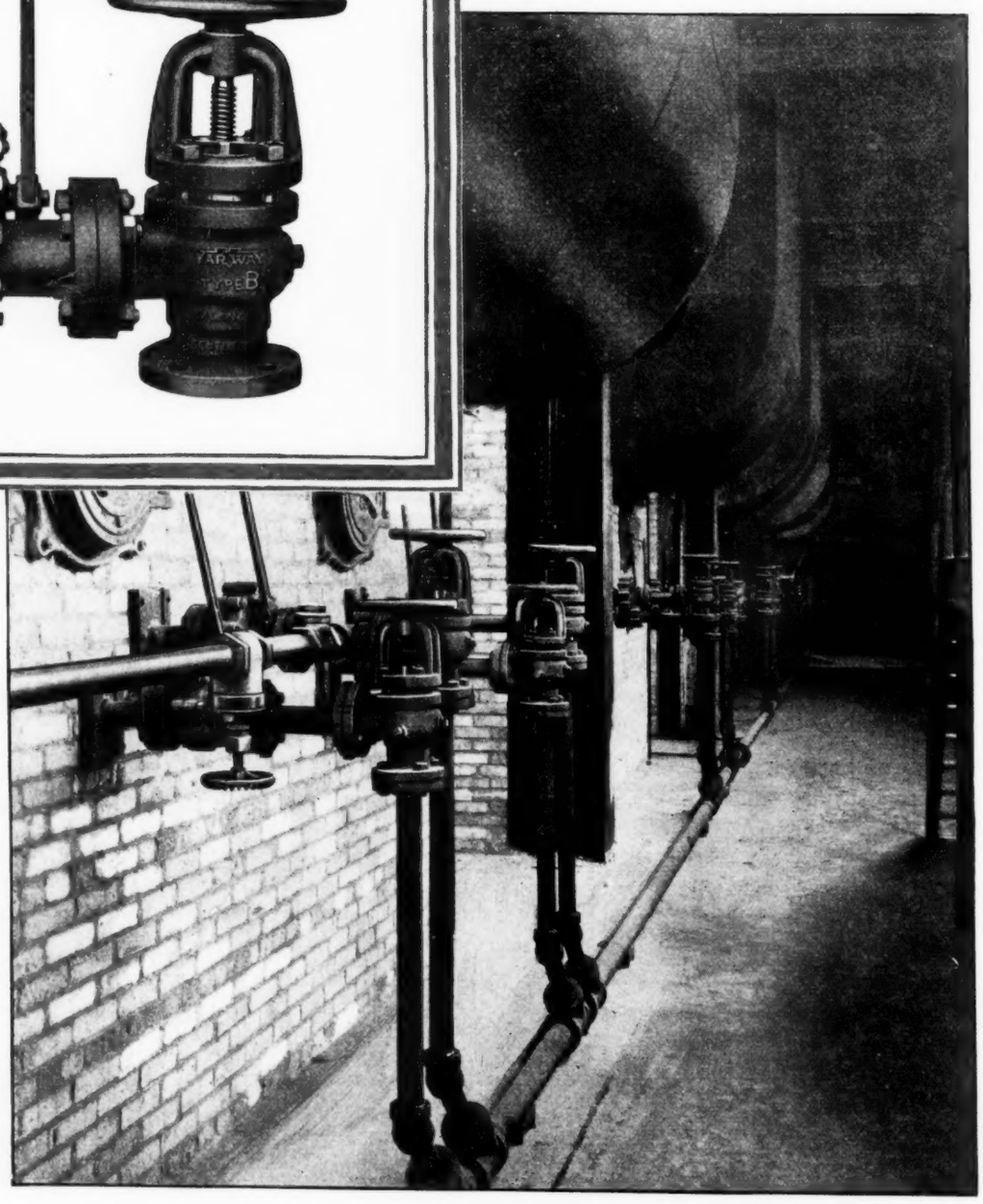
P6-28Gray

Representative Public and

YARWAY TANDEM

Fig. No. 3482-46

YARWAY SEATLESS BLOW-OFF VALVE in tandem with YARWAY DOUBLE-TIGHTENING VALVE. Made in sizes from 1½" to 4", angle or straightway, screwed or flanged ends. For pressures up to 250 pounds.



Boiler room of Milwaukee County Infirmary, Wauwatosa, Wisconsin, using 20 sets 2" No. 3482-46 YARWAY TANDEM BLOW-OFF VALVES (operating pressure 250 pounds).

YARWAY

BLOW-OFF VALVES

Universities, Schools, Institutions, Municipal Buildings using Yarway Blow-off Valves

Schools, Universities and Colleges

Oakwood Junior College	Huntsville, Ala.
University of Colorado	Boulder, Colo.
Delaware College	Newark, Del.
Emory University	Atlanta, Ga.
University of Illinois	Urbana, Ill.
Indiana Girls School	Indianapolis, Ind.
State University of Iowa	Iowa City, Iowa
St. Mary's College	St. Mary's, Kans.
Berea College	Berea, Ky.
St. Vincent Academy and Convent	Shreveport, La.
Wellesley College	Wellesley, Mass.
Mass. Inst. of Technology	Cambridge, Mass.
University of Michigan	Ann Arbor, Mich.
University of Minnesota	Minneapolis, Minn.
University of Mississippi	Oxford, Miss.
University of Missouri	Columbia, Mo.
State University	Missoula, Mont.
University of Princeton	Princeton, N. J.
New York University	New York City
Rensselaer Polytechnic Institute	Troy, N. Y.
N. C. State Col. of Agri. and Eng.	Raleigh, N. C.
N. D. Agricultural College	Fargo, N. D.
Ohio State University	Columbus, Ohio
University of Penna.	Philadelphia, Pa.
Farman University	Greenville, S. C.
University of South Dakota	Vermillion, S. D.
Vanderbilt University	Nashville, Tenn.
University of Tennessee	Knoxville, Tenn.
A. M. College	College Station, Texas
University of Washington	Seattle, Wash.
University of Wisconsin	Madison, Wis.

Hospitals

Bryce Hospital	Tuscaloosa, Ala.
U. S. Naval Hospital	Mare Island, Calif.
Montreal General Hospital	Montreal, Canada
Delaware Hospital	Wilmington, Del.
U. S. Naval Hospital	Washington, D. C.
Temple Hill Hospital	Chefoo, China
Kankakee State Hospital	Kankakee, Ill.
Northern Hospital for Insane	Logansport, Ind.
Johns-Hopkins Hospital	Baltimore, Md.
Mass. Homeopathic Hospital	Boston, Mass.
Ionia State Hospital	Ionia, Mich.
St. Mary's Hospital	Duluth, Minn.
Cooper Hospital	Camden, N. J.
Fifth Avenue Hospital	New York City
Roosevelt Hospital	New York City
State Hospital	Morgantown, N. C.
Germantown Hospital	Germantown, Phila., Pa.
Homeopathic Hospital of R. I.	Providence, R. I.
Yankton State Hospital	Yankton, S. D.
St. Mark's Hospital	Salt Lake City, Utah.
Western State Hospital	Staunton, Va.
Milwaukee Hospital	Milwaukee, Wis.

Institutions

Colorado State Insane Asylum	Pueblo, Colo.
Georgia State Sanitorium	Milledgeville, Ga.
The State Sanatorium	Oakdale, Iowa.
U. S. Penitentiary	Leavenworth, Kans.
Maryland Tuberculosis Sanatorium	Sanatorium, Md.
Industrial School for Boys	Lansing, Mich.
Hastings State Asylum	Hastings, Minn.
State Institution for Women	Vineland, N. J.
Sing Sing Prison	Ossining, N. Y.
State Tuberculosis Sanatorium	Dunseith, N. D.
State School for the Blind	Columbus, Ohio
Eastern State Penitentiary	Philadelphia, Pa.
Central Hospital for Insane	Nashville, Tenn.
State Confederate Soldiers' Home	Austin, Texas
West Virginia Asylum	Huntingdon, W. Va.
Wisconsin Home for Feeble Minded	Chippewa Falls, Wis.

Water Works

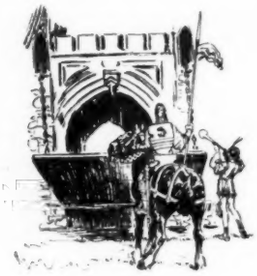
Central Water Works	Edgewater, Ala.
Board of Public Water Works	Pueblo, Colo.
Tampa Water Works	Tampa, Fla.
Lakeview Pumping Station	Chicago, Ill.
Indianapolis Water Works	Indianapolis, Ind.
City of Pratt, Water and Elec. Dept.	Pratt, Kans.
Paducah Water Supply Co.	Paducah, Ky.
Met. Water & Sewerage Board	Hyde Park Sta., Boston, Mass.
Cadillac Water & Lt. Co.	Cadillac, Mich.
City of Two Harbors	Two Harbors, Minn.
Metropolitan Water District	Omaha, Nebr.
City of Dover, N. H., Water Works	Dover, N. H.
Water Department	Atlantic City, N. J.
Board of Public Works Pumping Sta.	Poughkeepsie, N. Y.
City of Cleveland, Fairmount Pumping Sta.	Cleveland, Ohio
City Water Works	Tulsa, Okla.
Bureau of Water	Philadelphia, Pa.
City of Clinton, Water & Light Dept.	Clinton, S. C.
Electric Lt. & Water Dept.	Howard, S. D.
Milwaukee Water Works	Milwaukee, Wis.

Municipal Buildings

Municipal Building	Wilmington, Del.
Public Bldgs. & Public Parks	Washington, D. C.
State Capital Power House	Springfield, Ill.
Michigan State Administration Board	Lansing, Mich.
State Capital	Harrisburg, Pa.

YARNALL-WARING COMPANY
Mermaid Avenue Philadelphia

TEN THOUSAND PLANTS ARE YARWAY-EQUIPPED



INDUSTRIAL ADVERTISING
Opened the Door

MORSE pleaded with ten Congresses before his telegraph received any attention.

BELL nearly starved while the people laughed before the possibilities of his telephone were recognized.

Handicapped by a lack of prestige or influential introduction! The uphill struggles of these pioneers would have been much easier if in some way they had first gained the confidence of the minds they sought to sway.

The same situation exists in Industrial Selling. When an idea runs counter to established custom, although it be sound as gold, it needs an influential introduction to gain recognition for itself.

Morse & Bell Up to Date

A manufacturer sought to make Industry reverse its thinking and adopt a method which would revolutionize its production methods. His opposition was the groove of custom and the lack of recognition or influential approval. His allies were economy and speed in manufacture and strength in fabricated product. Nothwithstanding a meritorious idea little progress was made until the manufacturer added another ally—the sound use of Industrial Advertising.

For this purpose 3% of gross sales was appropriated. Advertising copy that especially recognized Industry's common trait to accept nothing new without careful weighing and deliberation, was persistently published in McGraw-Hill Publications reaching the industries which could profit from the new method.

Before a year was out many worthwhile installations of the revolutionary process were made. Prospective users openly stated that they eagerly watched these publications for each new advertisement in the campaign.

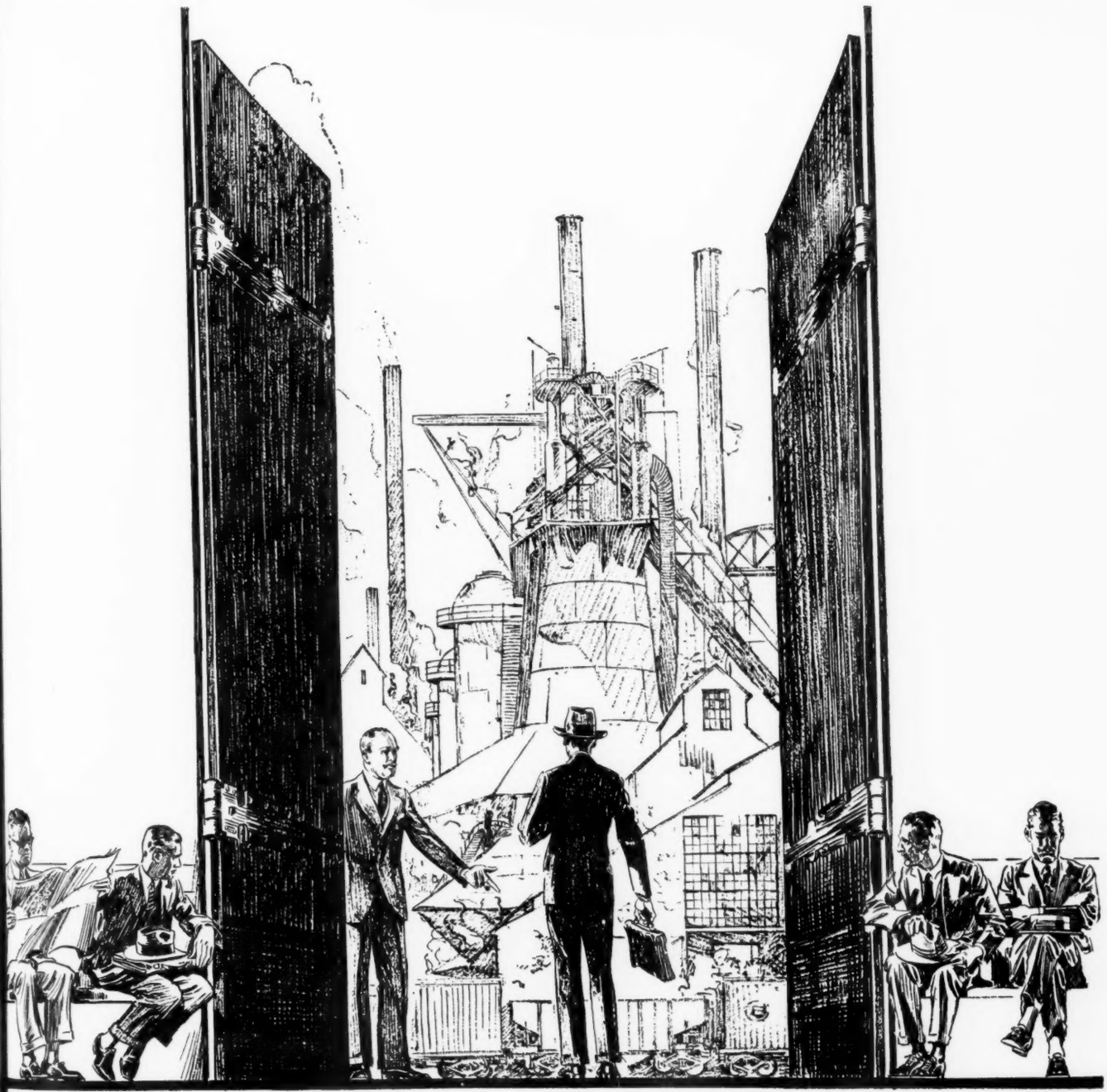
Changes An Industrial Practice

The surface is but scratched although the process is being rapidly extended. The Industrial Advertising carries on, writing on the wall another great change in industrial practice.

It is a curious anomaly that the eagerness of Industry for better products and methods is obstructed by disinterest and even suspicion when new ideas are not supported by the influential introduction that Industrial Advertising can give them.

McGraw-Hill Publications, possessing the confidence of industrial readers, provide the influential introduction which turns indifference into recognition. A study of the McGraw-Hill Four Principles of Industrial Marketing shows how Industrial Advertising holds the power to open buyers' doors and minds. McGraw-Hill, with its reservoir of data and experience, may be freely consulted by any manufacturer or his advertising agency in coping with all phases of industrial marketing problems.

A new book, "Industrial Marketing at Work," has just been published to show how to make a step-by-step application of these Four Principles. If Industry is your customer this book will help establish your advertising and selling on a foundation of certainty. Ask the nearest McGraw-Hill office to deliver a copy.



McGRAW-HILL PUBLISHING COMPANY, INC., NEW YORK, CHICAGO, PHILADELPHIA, CLEVELAND, ST. LOUIS, SAN FRANCISCO, LONDON. PUBLISHERS OF

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RADIO TRADE CATALOG
ELECTRICAL TRADE CATALOG
CENTRAL STATION DIRECTORY
ELECTRIC RAILWAY DIRECTORY
KEYSTONE COAL BUYERS CATALOG
KEYSTONE COAL MINING CATALOG
ELECTRICAL ENGINEERING CATALOG
KEYSTONE METAL QUARRY CATALOG
ANALYSIS OF METALLIC AND NON-METALLIC MINING, QUARRYING AND CEMENT INDUSTRIES
BONBRIGHT SURVEY OF ELECTRIC POWER & LIGHT COMPANIES IN THE U. S.

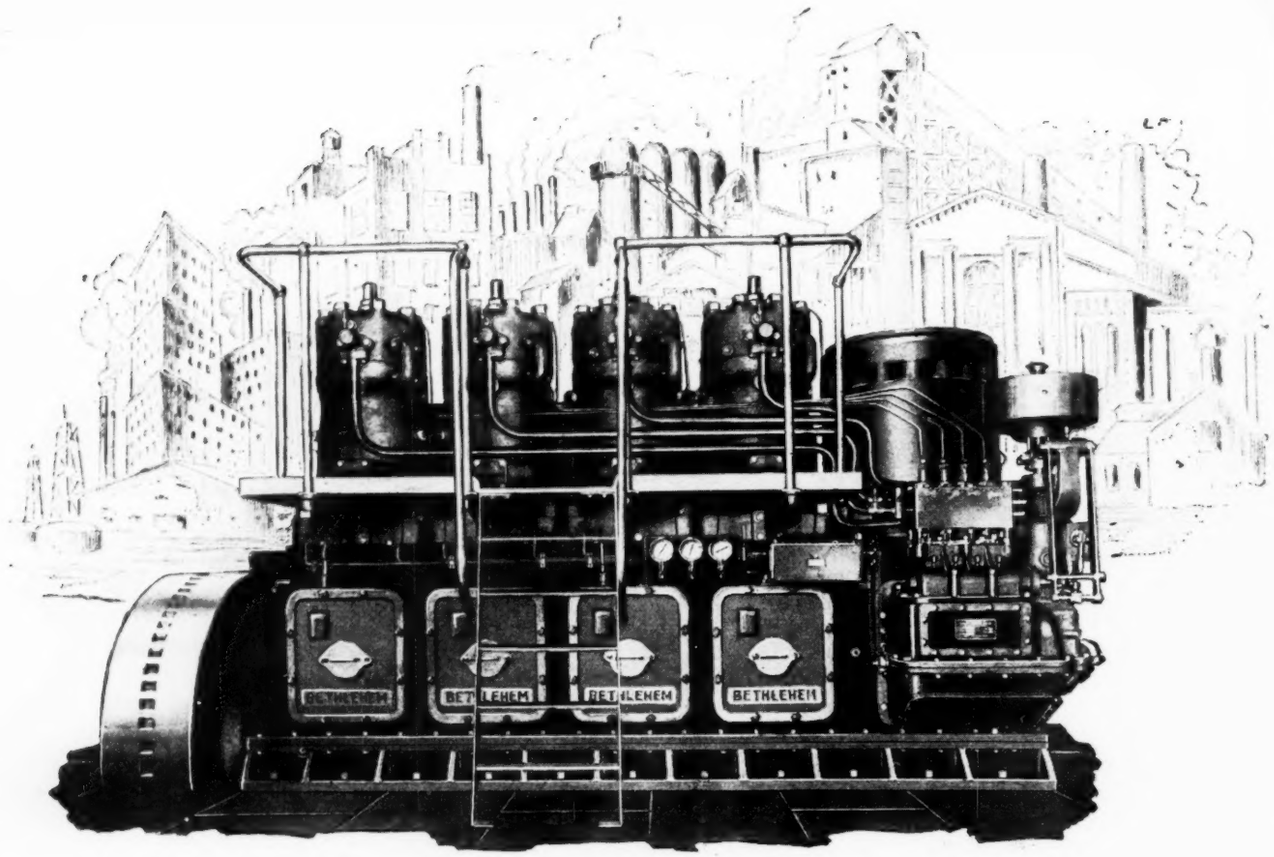
Radio
RADIO RETAILING

Transportation
BUS TRANSPORTATION
ELECTRIC RAILWAY JOURNAL

Mining
COAL AGE
ENGINEERING & MINING JOURNAL

Overseas
INGENIERIA INTERNACIONAL
AMERICAN MACHINIST
(EUROPEAN EDITION)

43,000 ADVERTISING PAGES USED ANNUALLY BY 3,000 MANUFACTURERS TO HELP INDUSTRY BUY MORE EFFECTIVELY



Bethlehem Diesel Engines

Type S-for Industrial Service

That power users are realizing the many advantages of Diesel engines is proved by the daily increase in the number of Diesel engine installations. Of the many features that have gained prominence for the Diesel engine, the outstanding one is its high thermal efficiency, which is more than twice that of a steam plant of the same power capacity.

Bethlehem Diesel Engines are not surpassed in thermal efficiency by any other oil burning engine. The character of the construction of the Bethlehem engine and the high quality of the materials used in its manufacture assure long life with utmost economy and reliability.

Bethlehem Diesel Engines Type S are built in units of 2, 3, 4 and 6 cylinders—sizes ranging from 60 to 570 b. hp.

Advantages of Diesel Engine Operation

Saving of Fuel—Only one-third the amount of fuel is burned by a Diesel engine as in a Steam Plant of the same power capacity.

Saving in Labor—No cleaning or repairing of boilers, condensers, steam and water piping.

Quick Starting—Only a few minutes are required to start a Diesel engine from the cold condition, as against several hours to raise steam to operating pressure in a boiler.

Stand-By Losses Eliminated—When a Diesel engine stops, the fuel consumption stops.

Features of Bethlehem Diesel Engines

- Maximum Simplicity
- Minimum Floor Space
- No Cam Shafts
- No Valve Operating Gear on Cylinders
- Airless or Solid Fuel Injection (Leissner System)
- Attached double acting Scavenging Pump
- Water-cooled Cylinders, Heads and Exhaust
- Low Exhaust Gas Temperature
- Air Starting
- High Cylinder Compression (ensuring quick starting)
- Simple Control System
- Forced feed Lubrication
- Attached auxiliary pumps
- Two Stroke Cycle
- Dependability and economy

Catalog on Bethlehem Diesel Engines gladly sent on request. Simply write your name, firm and address in the coupon and mail to:

BETHLEHEM STEEL COMPANY *General Offices:* Bethlehem, Pa.

DISTRICT OFFICES:

New York Boston Philadelphia Baltimore Washington Atlanta Pittsburgh Buffalo Cleveland Detroit Cincinnati Chicago St. Louis San Francisco Los Angeles Seattle Portland

Bethlehem Steel Export Corporation, 25 Broadway, New York City, Sole Exporter of our Commercial Products

BETHLEHEM

P
6-27

Bethlehem
Steel Co.,
Bethlehem, Pa.

With no obligation on my part, please send me your catalog on Bethlehem Diesel Engines—Type S.

Name .....

Firm .....

Address .....

The bond behind the lining

CHARTERED APRIL 22ND 1874

The Metropolitan

IT IS UNDERSTOOD AND AGREED that ... one (1) ... the lining does spall ... furnish to any purchaser ... through new "Ramtite" to replace the material ... guarantee, the ... date of installation, The S. Ober- ... at its Home ... such cl... days ... the l... purch... ($25,... are fi... Dollar ... bond.

SIGNED, ...

THE protection of the cash guarantee bond is offered to every RAMTITE user who complies with one simple condition, that the RAMTITE lining be installed in accordance with the practice recommended by its makers, the S. Obermayer Company.

RAMTITE'S uniform record of long life under hard service has demonstrated the advantages of this plastic monolithic lining and in accordance with this 53-year old company's policy, the cash guarantee bond has been established.

The bond provides that should any installation made as recommended crack or spall so badly as to give unsatisfactory service, the S. Obermayer Company will furnish without cost enough RAMTITE to replace the material that failed.

Only RAMTITE'S quality and demonstrated performance could make such an iron-clad guarantee possible. This, then, the bond behind the lining, is the final proof of RAMTITE'S superiority over ordinary refractories.

Full details of the cash guarantee bond and of RAMTITE are available on request.

THE S. OBERMAYER COMPANY

2563 W. 18th Street, Chicago, Illinois

Canadian Distributors:
Riley Engineering & Supply Co., Ltd., 360 Dufferin St., Toronto 3, Canada.

P6-28-Gray

Manufacturing Plants
Chicago, Cincinnati, Pittsburgh, and Springfield, Mass.

Carried in stock in 26 cities.
Also manufacturers of HOTT-PATCH and other high temperature cements.

RAMTITE

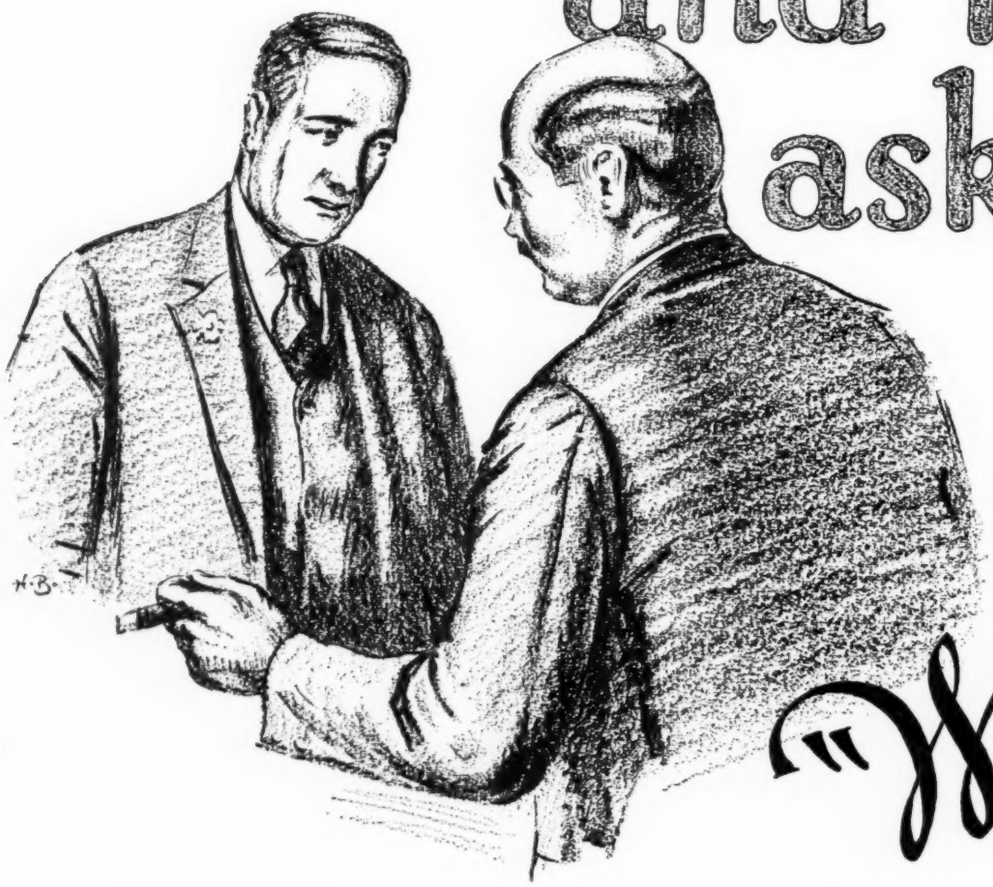
The S. Obermayer Company, 2563 W. 18th ... Chicago

Please send me ... tails of the guaran ... bond and informat ... on RAMTITE.

Name .....

Company .....

and men a
asking e



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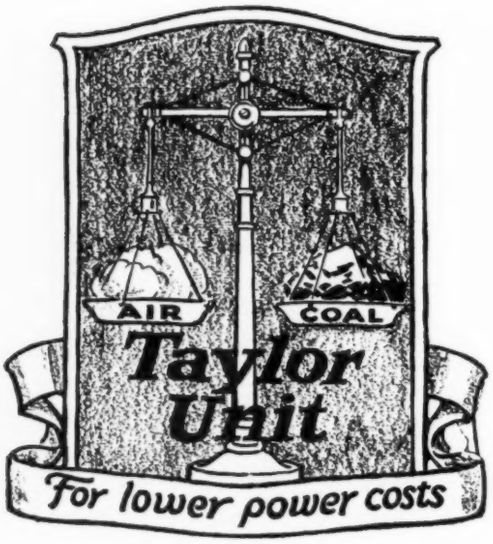

are each other about this "Taylor Unit" from a pound of coal"

Overnight, almost, new standards of combustion efficiency have become a reality! Reduction of power costs undreamed of but a short while ago are now within the bounds of accomplishment.

Control—control of air and control of coal—control of combustion with an accuracy hitherto confined to the laboratory, is being realized on a commercial basis. And the new instrument, the system that makes it possible, has been perfected.....is now READY! And everywhere men of vision are asking each other—"What about this new TAYLOR UNIT?"

AMERICAN ENGINEERING COMPANY

Aramingo and Cumberland Sts.,

PHILADELPHIA, PA.

For more steam p
a Pulverburner or

The high combustion efficiency of a pulverized-fuel installation gives this equipment a big advantage in the amount of steam produced per dollar. The economy rating of a pulverizer depends on the uniform fineness of its grinding, the low power cost of its operation, and the dependability of the equipment over long periods.

The combination of impact and grinding used in the Pulverburner insures uniform pulverization. The low power-consumption records made by this machine in recent years are unsurpassed. A look at the equipment or a study of the new catalog will answer any question as to the rugged construction and absence of upkeep expense. May we send the new catalog?

Illinois Stoker Company
Alton, Illinois

Vickers Boiler Company, Limited
Broadway Buildings, 50-64 The Broadway, Westminster, London S.W.1, England

Chicago
Ernest E. Lee Co.
115 S. Dearborn Street

Kansas City, Mo.
J. F. Pritchard & Co.
503 Dwight Bldg.

Indianapolis, Ind.
I. C. DeHaven Eng'g Co.
State Life Building

THE PULVERBURNER

per dollar use
or an Illinois Stoker

THE dampered air control of the Illinois Chain Grate Stoker is the key to economy which has won so many staunch friends for this equipment. Economical combustion has been proven by Illinois Stoker design on all types of boilers and with all grades of coal. Consulting engineers and plant executives responsible for the scores of big installations of Illinois Stokers require the fullest assurance of economical steam generation. We invite inspection of the records at the Des Moines Power & Light Corporation, National Plate Glass Company, Carnegie Steel Company, Commonwealth Edison Company, Illinois Traction System, and many others.

Catalog L contains details of some of the noteworthy economy records. Ask for a copy.

Illinois Stoker Company
Alton, Illinois

New York, N. Y.
Illinois Stoker Co.
1946 Grand Central Terminal Bldg.

Minneapolis, Minn.
H. J. Meier
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Dallas, Texas
J. P. Greenwood
935 Allen Building

Pittsburgh, Pa.
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710 Magee Building

ILLINOIS STOKERS
CHAIN GRATE With Dampered AIR CONTROL

P6-28-Gray

In the

Whether in Australia, Japan, South America or the United States, the sign of the modern power plant is the sign of International Combustion equipment, installed by affiliated companies, built by subsidiaries, guaranteed by service that requires no bond of performance.

the Land of the Kangaroo

Australia!—

There too, at Morwell, you will find tangible evidence of the world-wide influence exerted by International Combustion Engineering Corporation in the installation of steam generating units, economical and dependable in the generation of power.

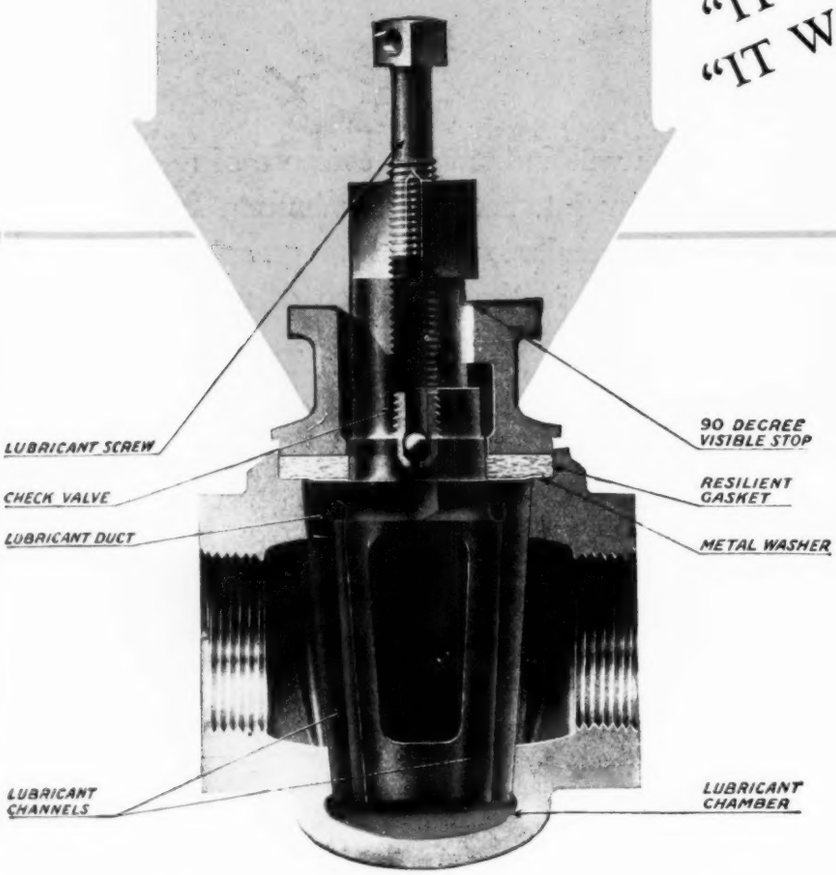
Distance is no barrier to International Combustion. To distant islands, colony possessions and busy industrial continental centers, the affiliated companies of International Combustion Engineering Corporation are bringing the benefits of their pioneer research into all phases of modern combustion problems. These companies are continually reaching out for new fuel economies. They are making available the benefits of pioneer research. All over the world, combustion units representing the specialized products of twenty subsidiaries are advancing power plant practice and making it possible for civilization and industry to progress along lines undreamed of before this great international service made available its experience and the methods whereby new eras of economy and efficiency are open.

International Combustion Engineering Corporation
International Combustion Building
New York City

A Single Operation Raises and Lubricates the Plug

Renewable sticks of lubricant—especially compounded for the service—are inserted in the hollow shank of the plug. A turn of the lubricating screw forces the grease through the ducts in the plug into the closed bottom lubricant chamber, where it exerts a lifting pressure against the base of the plug. This raises the plug instantly against the resilient gasket and causes the lubricant to spread over the entire bearing surface, sealing it tightly against leakage.

"IT WON'T LEAK"
"IT WON'T STICK"



That is why the Merco Nordstrom gives ideal service. Use it wherever tight valves are required on lines or connections carrying steam, hot or cold water, ammonia, gas, air, oil, acids, alkalis or any high or low specific gravity fluid. Sizes ½ to 24 in.

Write for Catalog No. 5

MERCO NORDSTROM VALVE COMPANY

SUBSIDIARY OF THE MERRILL COMPANY

Engineers— MERCO *Manufacturers*

San Francisco	New York	Chicago	Houston	Cleveland	New Orleans
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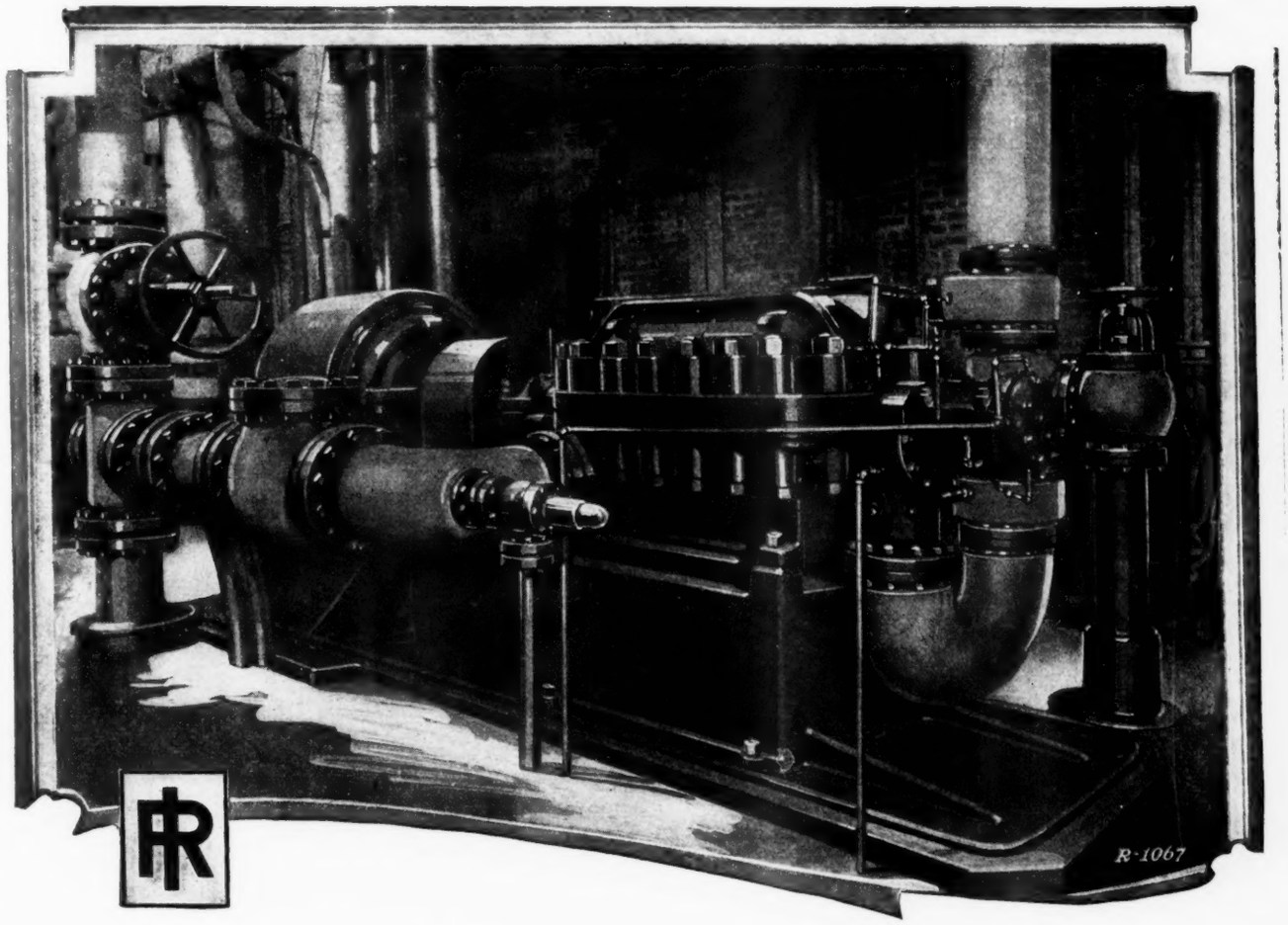
Factories: Belleville, N. J.; Oakland, California

Merco Nordstrom PLUG VALVES



"Cameron" Pumps for Central Stations

For the past sixty years Cameron has maintained leadership in the pump industry.

It is logical, therefore, that the central stations, when confronted with high steam pressures and capacities, should depend upon Cameron to solve their boiler feeding problems.

Because of their reliability and efficient operation, the Cameron HMT Boiler Feed Pumps have been chosen by the country's foremost central stations.

These pumps are furnished in sizes having from two to six stages, with capacities and heads suitable for all purposes.

Send for Complete Set of Ingersoll-Rand & Cameron Bulletins.

INGERSOLL-RAND COMPANY : 11 Broadway · New York City

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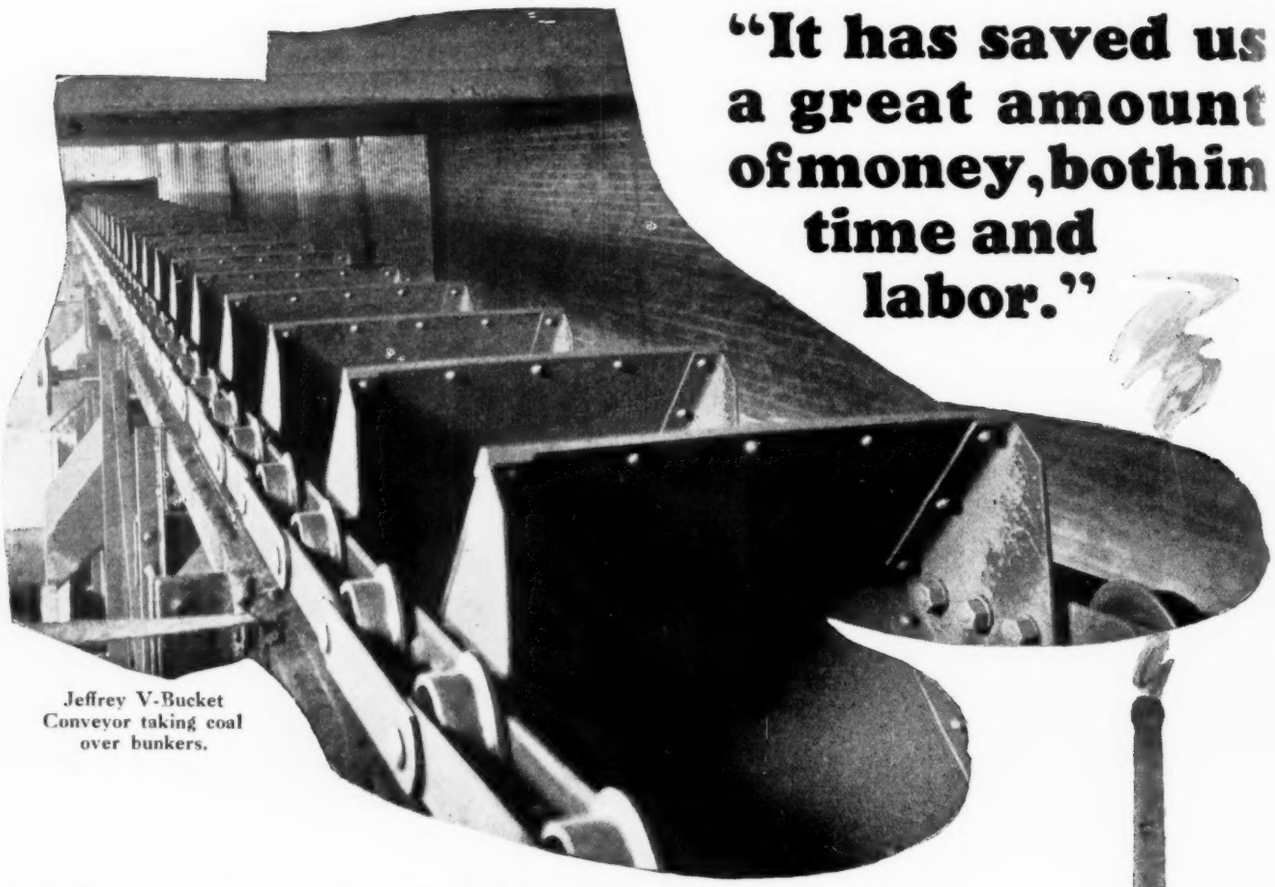
A. S. CAMERON STEAM PUMP WORKS

"It has saved us a great amount of money, both in time and labor."



Jeffrey V-Bucket Conveyor taking coal over bunkers.

In 1922 the Godman Shoe Company of Columbus, Ohio, installed this Jeffrey V-Bucket Conveyor at their West Broad Street plant to carry coal from unloading pit to bunkers.

The only replacement in the five years' continuous operation of this equipment was a small casting on the motor frame costing less than five dollars. The Chief Engineer says, "Undoubtedly it has saved us a great amount of money, both in time and labor."

The Jeffrey V-Bucket takes the coal up forty feet vertically and distributes it horizontally over fifty feet of bunkers. The twenty-inch buckets are mounted on Jeffrey 276 Steel Thimble Roller Chain.

Write for the Jeffrey bulletin describing Eight Methods of Handling Coal and Ashes.

This power house of the Godman Shoe Company at Columbus, Ohio, furnishes the power to their plant which manufactures 12,000 pairs of children's Sphinx Brand shoes daily.

The Jeffrey Manufacturing Company

932-99 North Fourth St., Columbus, Ohio

New York, Buffalo, Rochester, N. Y., Philadelphia, Pittsburgh, Scranton, Pa., Boston, Cincinnati, Cleveland, Detroit, Chicago, Charleston, W. Va., Milwaukee, St. Louis, Denver, Salt Lake City, Los Angeles, Birmingham, Charlotte, N. C., Montreal

50 YEARS OF SERVICE TO INDUSTRY

JEFFREY

MATERIAL HANDLING EQUIPMENT

Jeffrey Products

Elevators—Conveyors
Portable Loaders
Coal and Ashes Handling Equipment
Skip Hoists
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Sand and Gravel Handling, Washing and Screening Equipment
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Coal Mine Equipment
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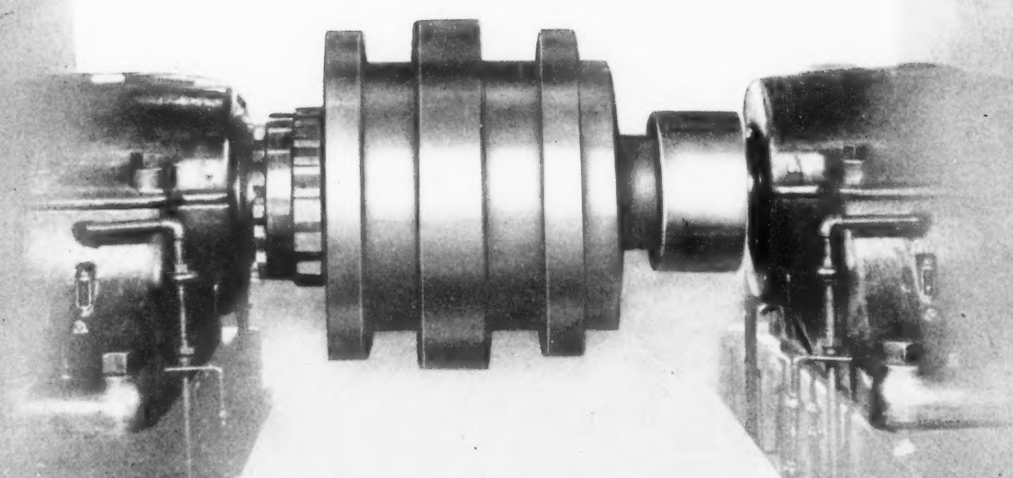


Fast's Coupling will be there when the machines are gone

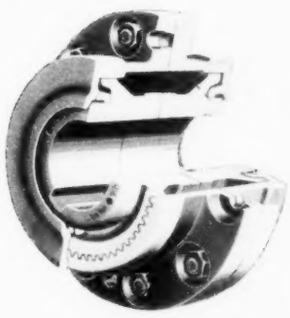
FAST'S FLEXIBLE COUPLINGS are built to outlast the connected machines. That's one of the advantages of a *purely mechanical flexibility*. There is no rubber, leather, fibre, laminated steel pins, springs, grids, discs or other flexible materials to fatigue and fail and shorten the life of the coupling. FAST'S is a *permanent* piece of transmission machinery with nothing to get out of order, no parts to replace.

Long life is only one reason for installing FAST'S. Suitable for low or high speed, heavy duty or reversing drives, it compensates for all forms of shaft misalignment, eliminates all whip and crank action, allows free lateral float. A coupling that's worthy of your investigation. The new catalog will tell you the whole story. Write for it today.

FAST'S FLEXIBLE COUPLING

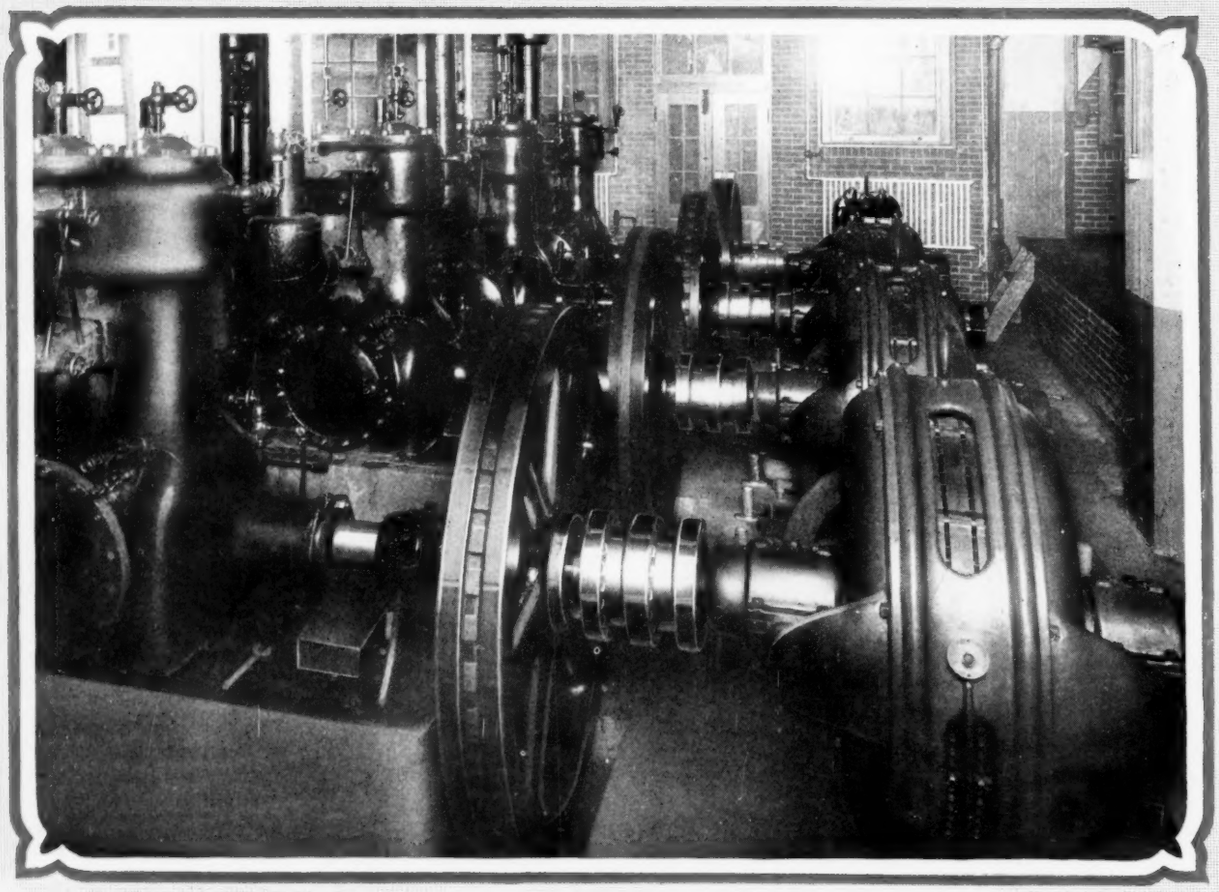
FAST'S PRINCIPLE
of Mechanical Flexibility

Two generated spur gears, one on each shaft end, are continually and completely meshed in oil with the internal gears of a floating sleeve. The shafts and sleeve revolve as one unit, allowing the connecting sleeve free lateral and angular play.



THE
BARTLETT HAYWARD
COMPANY

SCOTT and McHENRY STS.
BALTIMORE, MD.



FAST'S FLEXIBLE COUPLING

FAST'S FLEXIBLE COUPLINGS, 60 H.P. at 167 R.P.M., on Synchronous Motor-Driven Ammonia Compressors, Western Maryland Dairy, Baltimore, Md.

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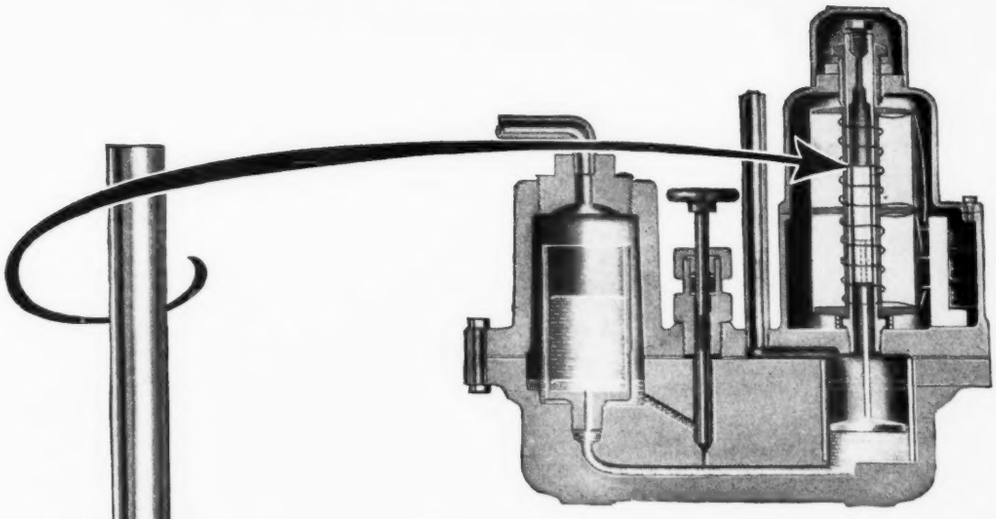
Special Type COUPLINGS

FAST'S FLEXIBLE COUPLING may be had in special types, variations of the standard design, but retaining all the features of mechanical flexibility. Perhaps you have some special drive requiring a special type of flexible coupling that will compensate for shaft misalignment, one that will allow free end float, one that will operate without danger of failure or breakdown. Write us. Give shaft sizes. Send a drawing if possible. Our Engineering Department can no doubt design the proper type of FAST'S COUPLING to meet your unusual requirements.

WRITE FOR NEW CATALOG

See Preceding Page



No other flow meter has this feature

No Electrical Parts in Pressure Chamber No Mechanical Parts going out of it

NO RESISTANCE elements. No make-and-break contacts. No voltage regulator. No compensator. No permanent magnets. Just an armature moving up and down within a coil, as the mercury rises and falls with changes in flow. Coil and all electrical parts are sealed from pressure chamber by non-magnetic, metallic tube, illustrated. Only by the use of the *inductance bridge principle,* exclusive with the Brown Electric Flow Meter, is this extraordinary simplicity possible in a flow meter. Completely described in Catalog No. 20. Write for a copy. The BROWN INSTRUMENT CO., 4401 Wayne Ave., PHILADELPHIA, PA. *Offices in 18 principal cities.*

5 Exclusive Advantages

1. *Inductance Bridge circuit.*
2. *Chart automatically planimetered.*
3. *Inherently independent of voltage fluctuations.*
4. *No electrical parts in pressure chamber. No mechanical parts going out of it.*
5. *Double-range manometer.*

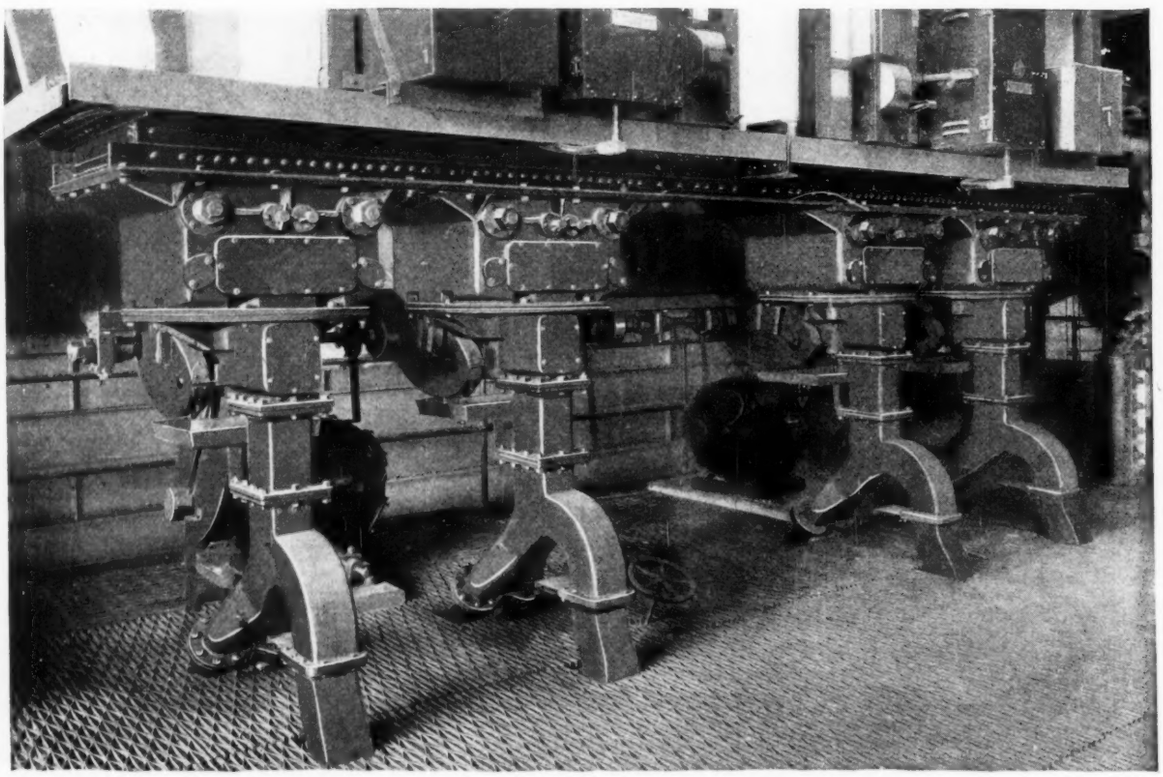
"To Measure is to Economize"—*Pascal*

Brown Electric Flow Meter

on the Inductance Bridge Principle

BAILEY FEEDERS

For all conditions



Installation at Narragansett Electric Light & Power Co., Providence, R. I.

The Bailey Feeder and Meter for pulverized coal is the selection of prominent engineers and operators.

Installations cover a wide range of conditions and a period of time which amply proves its merit.

Features of Bailey Feeders

No bridging—no flooding.
Shut-off gates easily and quickly closed.
Regular and positive feed.
A meter of high accuracy.
Will handle comparatively wet coal.
Delivers highly aerated coal—not compacted.
It is well adapted to automatic control.
Built in capacities up to 12,000 lbs. of coal per hour, each.

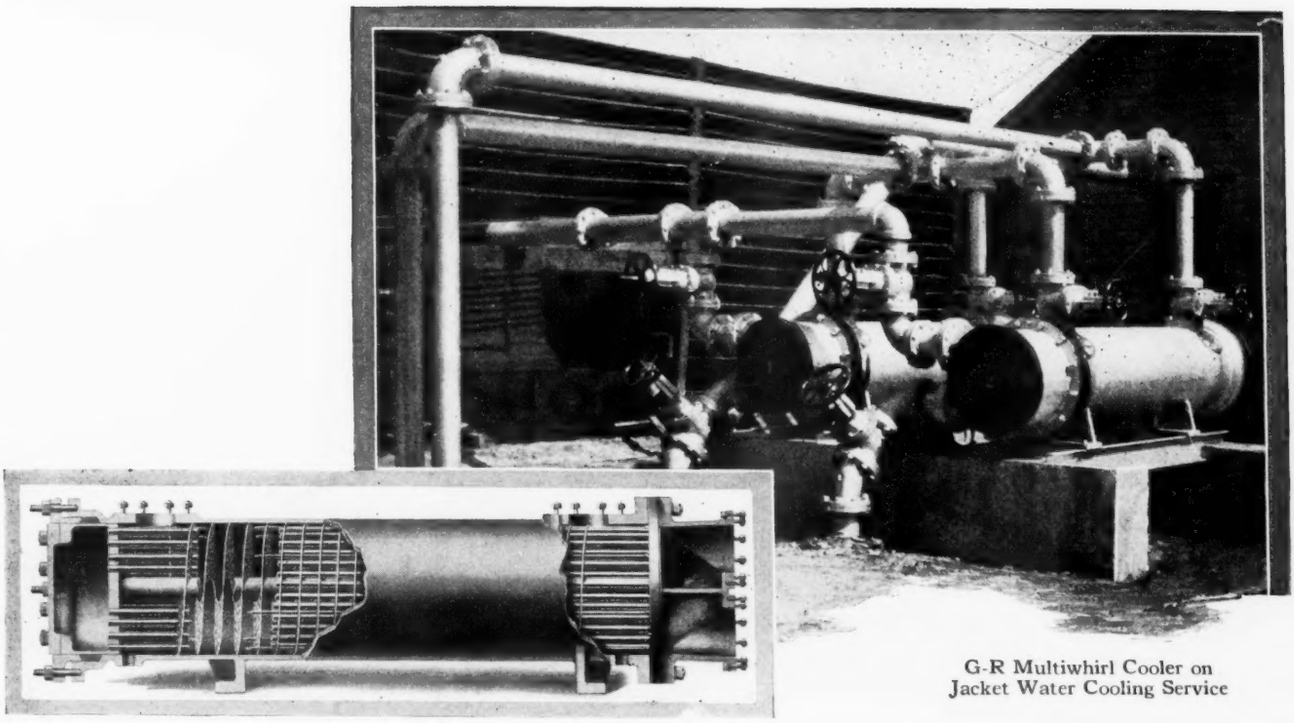
A Few Installations

Calumet Station, Commonwealth Edison Co., Chicago. (Sargent & Lundy, Inc., Engineers.)
Narragansett Electric Light & Power Co., Providence, R. I. (Jenks & Ballou, Engineers.)
New Orleans Public Service, Inc., New Orleans, La. (Electric Bond & Share Co.)
Colfax Station, Duquesne Light Co., Colfax, Penna. (Byllesby Engineering & Management Corp.)
Pine Grove Station, Phoenix Utility Co., Pine Grove, Penna. (Electric Bond & Share Co.)
Binghamton Light, Heat & Power Co., Binghamton, N. Y. (W. S. Barstow Management Association, Inc.)
Toronto Plant, Ohio River Edison Company, Toronto, Ohio. (Stevens & Wood, Inc., Engineers.)
Iron Mountain Plant, Ford Motor Company, Iron Mountain, Mich.

FULLER LEHIGH COMPANY

[A Babcock & Wilcox Organization]

FULLERTON----PENNSYLVANIA



G-R Multiwhirl Cooler on
Jacket Water Cooling Service

Keep cooling liquids at proper cooling temperatures

The G-R Multiwhirl Cooler
Thousands in use
One of the G-R Products for more efficient heat transfer

Turbine bearing oil will maintain its lubricating qualities better and can be used longer if kept at a low temperature. Similarly, transformer cooling oil will be more effective if the heat which it absorbs is steadily withdrawn. And in oil engines, a small amount of pure jacket water may be circulated over and over again if it is cooled before returning to the jackets.

These are some of the power plant applications in which a G-R Multiwhirl Cooler will help to reduce maintenance costs and improve operation. Thousands of these coolers are in service—the best possible proof of their effective and profitable features.

Write for bulletin

THE GRISCOM-RUSSELL COMPANY
285 Madison Ave., New York

Philadelphia	Chicago	St. Louis	San Francisco
Boston	Cleveland	New Orleans	Los Angeles
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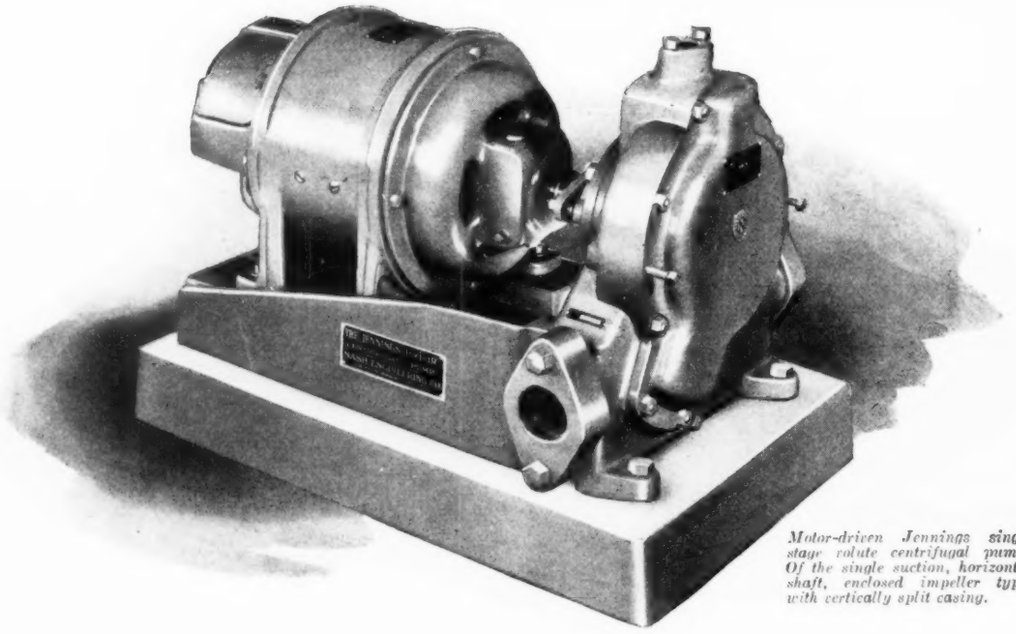
For Canada: Riley Engineering and Supply Company, Ltd., Toronto

Griscom-Russell **Heat Transfer Apparatus**



Motor-driven Jennings single stage volute centrifugal pump. Of the single suction, horizontal shaft, enclosed impeller type, with vertically split casing.

Motor and Pump on the same Shaft!

Jennings Centrifugals are supplied in capacities up to 1,000 g.p.m. against pressures up to and exceeding 100 lbs. for:

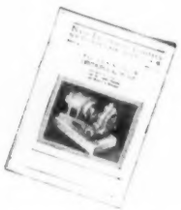
(*a*) circulating hot and cold water

(*b*) boosting city water pressure

(*c*) handling water in air washing and conditioning

(*d*) removing condensate from heating systems, blow down from soot blowers and superheaters, exhaust drips from steam ejector air pumps and other auxiliaries

(*e*) pumping refrigerator can and core water, evaporator feed, cooling tower and condenser water, screen wash water, oil engine jacket water, ash sluicing water



Bulletin No. 52 is the one to ask for.

In order to provide a more compact, dependable and sturdy unit, the impeller in the Jennings Centrifugal Pump is mounted on a short, stiff bronze extension of the motor shaft.

There is only one stuffing box. No bearings in the pump casing. By merely unscrewing a few bolts, the head can be taken down without breaking the piping connections or disturbing the shaft alignment.

Standard commercial speed motors are used. Shaft couplings are done away with. Efficiency is high—with a wide, flat characteristic.

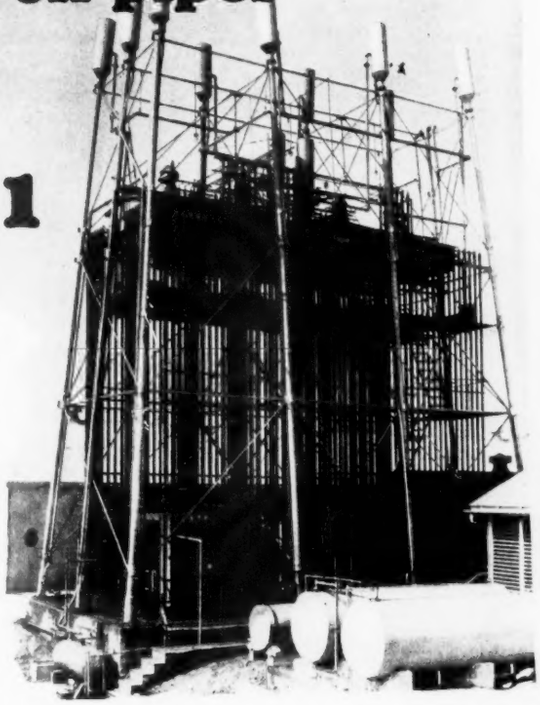
NASH ENGINEERING COMPANY
166 Wilson Road, So. Norwalk, Conn.

Jennings Pumps

Joints on hot and cold oil pipes

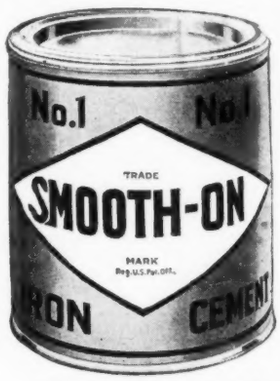
—never tight before; perfect since treating with

SMOOTH-ON No. 1



HERE is strong evidence that SMOOTH-ON No. 1 does make joints stay absolutely tight under wide temperature variation.

This heat interchanger, built in Tulsa, Okla., for a nationally prominent oil refining company company, is formed from 2-in. pipes placed within 3-in. pipes. Cold oil enters the inner pipe at the bottom and leaves at the top at 160 deg. fahr., and through the annular space between the two pipes, hot oil entering at the top at 450 deg. fahr. flows to the bottom and is reduced to 100 deg. fahr. Manifolds at top and bottom combine the circulating pipes into units, which are connected to the stills by pipes.



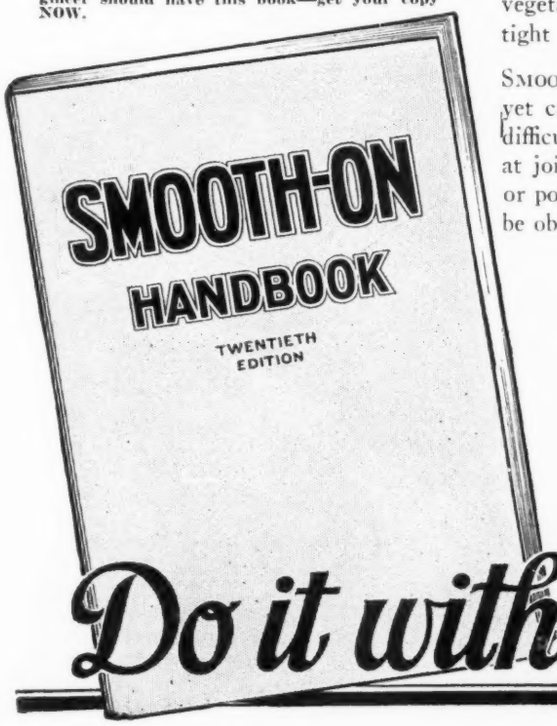
Litharge and glycerine were used at first for making all screw-thread connections, but the joints soon began to leak on account of the severe expansion and contraction strains. No other satisfactory joint filler could be found until SMOOTH-ON No. 1 was tried. SMOOTH-ON No. 1 has now been adopted for *all* the threaded joints and has proven entirely successful in stopping leakage of both hot and cold oil.

SMOOTH-ON No. 1 is thoroughly reliable even on lines containing gasoline which cuts right through any composition of an oily nature; it holds equally well on highly superheated steam lines, which bake and take the life out of vegetable and other semi-solid matter; it has the body to stand up and stay tight against pressures of over 1000 lb. per sq. in.

SMOOTH-ON No. 1 is the only composition which does all these things, and yet can be used at an insignificant cost and with no particular effort or difficulty in application. Use it in new construction for pressure tightness at joints, seams and rivets and in repair work on cracks, breaks, corroded or porous spots, weakened gaskets, etc., and you will make savings that can be obtained in no other way.

This BOOK FREE if you mail the coupon

Twentieth Edition—Completely rewritten—136 pages of new data—193 diagrams, pictures and practical hints on at least 200 different uses for SMOOTH-ON. Every progresssive engineer should have this book—get your copy NOW.



Get the* SMOOTH-ON *Handbook from us so that you can see the wide variety of practical applications, and get your* SMOOTH-ON *No. 1 in 1 or 5-lb. cans or 25, 50 or 100-lb. kegs from your nearest dealer or if necessary from us.

SMOOTH-ON MFG CO., Dept. 30, 570 Communipaw Ave., Jersey City, N. J.
Please send copy of the SMOOTH-ON HANDBOOK, 20th Edition.

Name .....

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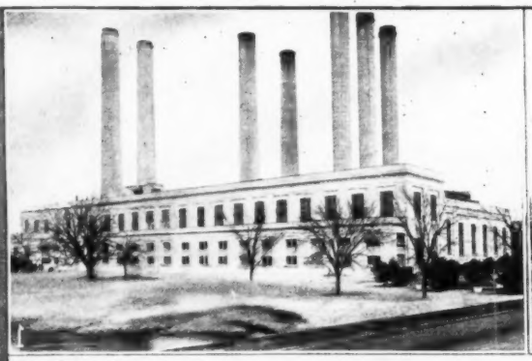
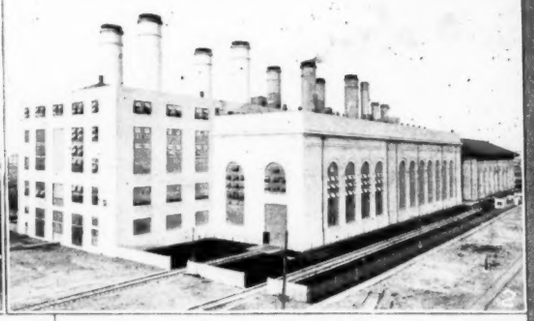
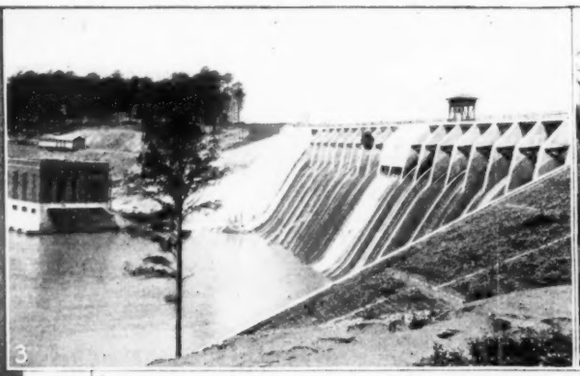
Do it with SMOOTH-ON

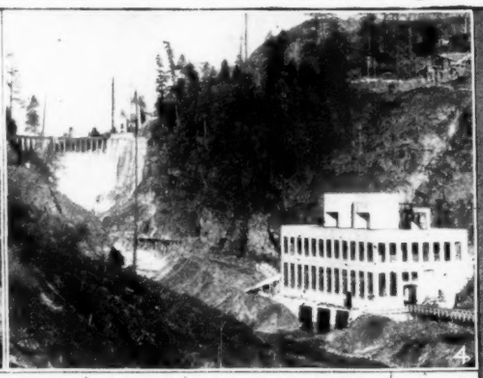
STEAM POWER STATIONS



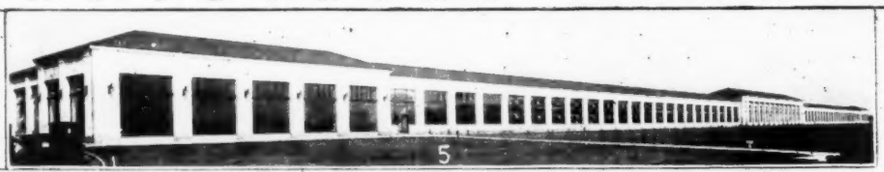


WATER POWER DEVELOPMENTS





INDUSTRIAL PLANTS



OFFICE BUILDINGS

RECENT WORK

1. Bennings Station, Potomac Electric Power Co., Washington, D. C., 75,000 Kw. Extension
2. Long Beach Station, Southern California Edison Co., Los Angeles, Cal.
3. Bartlett's Ferry Development, Columbus Electric & Power Company, Columbus, Ga.
4. Baker River Development, Puget Sound Power & Light Co., Seattle, Washington
5. Twin Cities Plant, Ford Motor Company, St. Paul, Minnesota
6. The First National Bank of Boston, Buenos Aires Branch, Buenos Aires, Argentine

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About the Selection of Flow Meters

BEFORE selecting a flow meter for your plant why not first familiarize yourself with the comparative advantages of the different types of meters for various purposes.

This Cochrane Bulletin treats of:

The selection of pipe orifices and flow nozzles for either steam or air.

The comparative advantages of orifice plates, flow nozzles, and Venturi tubes.

The field and advantages of V-notch Meters.

Boiler blow-off meters.

Special V-notch meter applications.

The discharge capacities of V-notch weirs.

Weighing meters for liquids.

Volumetric meters for use on shipboard.

Twelve good reasons are given as to why every boiler plant should have a feed water meter.

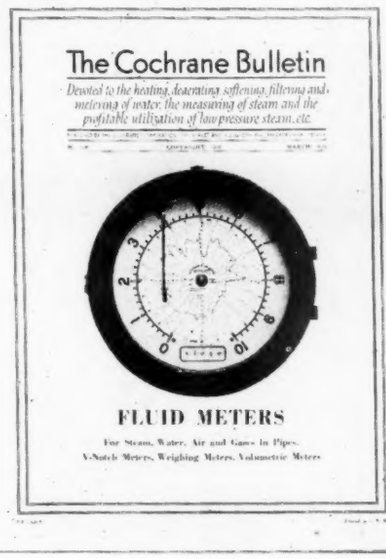
The bulletin also describes the Cochrane Flow Meter, which is distinguished by having no working parts within the pressure chambers and by having uniform graduations on the chart and on the integrator scale. Accuracy is guaranteed. Additional pens for pressure or temperature or for recording other power plant quantities can be supplied and an accurate integrator is part of the regular equipment.

Ask for Cochrane Bulletin L668

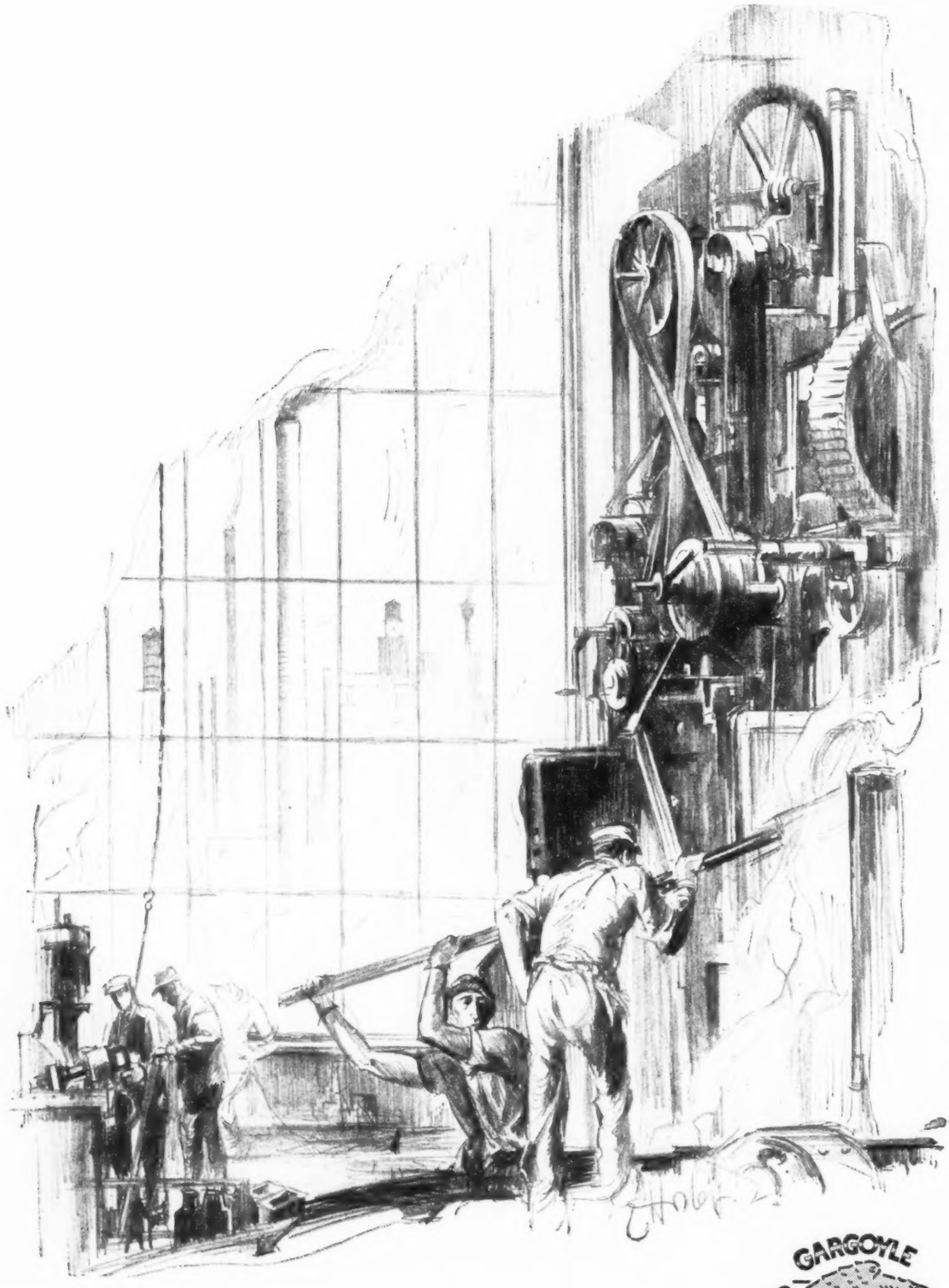
COCHRANE CORPORATION

17th and Clearfield Streets, Philadelphia, Pa.

384


The Cochrane Bulletin
Devoted to the heating, deaerating, softening, filtering and metering of water, the measuring of steam and the profitable utilization of low pressure steam, etc.
FLUID METERS
For Steam, Water, Air and Gases in Pipes
V-Notch Meters, Weighing Meters, Volumetric Meters

A sensible reason fo



GARGOYLE

Lubricating Oils
for Plant Lubrication

for your success

To Manufacturers of Quality Products

YOU naturally expect some competition based on substitution and cut prices. The imitator always stalks on the trail of established successes.

To meet price competition even your salesmen may ask for lower prices, but they would be unwilling to make quality concessions to obtain them.

You have traveled your set course too long to be induced to swerve.

This policy in your business undoubtedly is fixed. It has carried our business to its acknowledged world-wide leadership in the field of lubrication.

What effective lubrication will do

Prominent engineers assert that the effective life of machine equipment, by proper attention, can be extended one month for each year of service. Many say this annual saving of one-twelfth is far too conservative an estimate.

Correct oil correctly applied is the remedy for the chief cause of deterioration. The same remedy will forestall the causes of most engine and machine repairs, with consequent production interruptions, and will reduce power costs.

We stand ready to help any quality-minded manufacturer to establish and maintain a high standard of lubricating efficiency throughout his plant.

After our oils are installed our engineering staff cooperates with the plant personnel to check up results and, wherever possible, to better them.

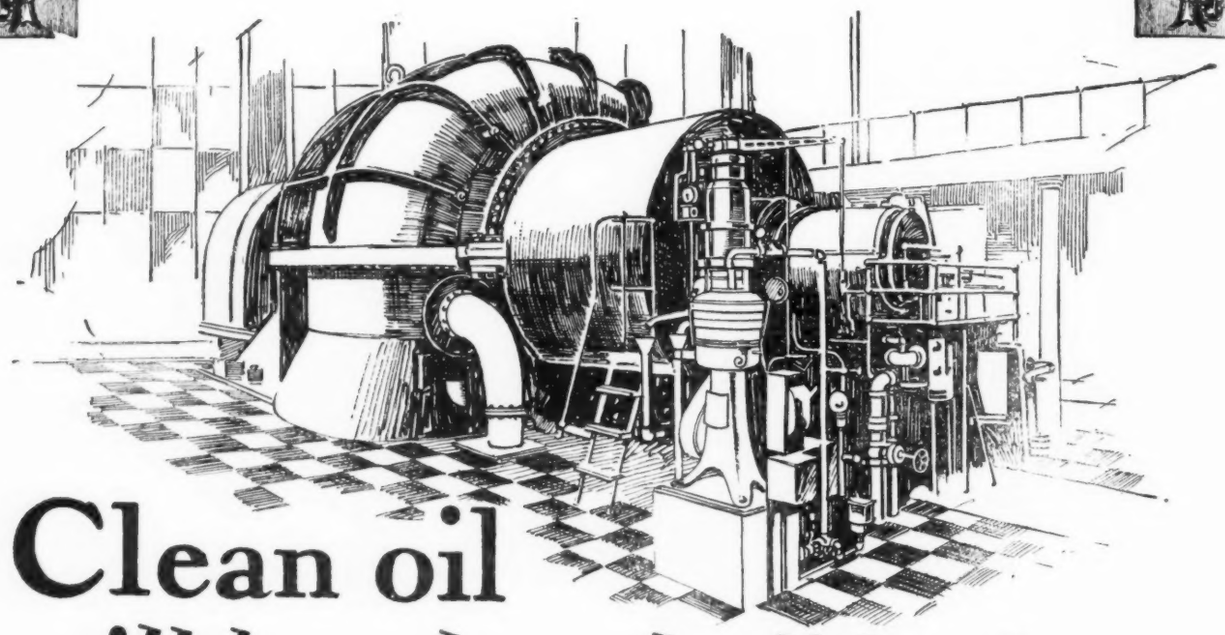
Our oils and our lubrication counsel, which are used by manufacturers of quality products throughout the world, are at your service.

Vacuum Oil Company

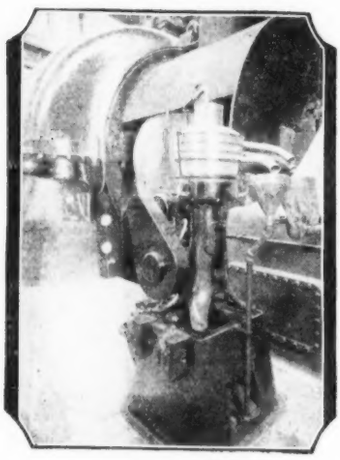
Headquarters: 61 BROADWAY, NEW YORK

Branches and distributing warehouses throughout the country

ELIMINATE WASTE IN INDUSTRY



Clean oil *will lengthen the life of your* TURBINES . . .



At the Twin Branch station of Indiana and Michigan Electric Company, De Laval Oil Purifiers are connected into each turbine lubricating system as shown above, so that a portion of the oil in circulation is continuously by-passed to them. The Purifiers centrifuge out water, sludge and other impurities, returning the oil to the turbine reservoir with its lubricating efficiency fully restored.

De Laval centrifugally purified oil is clean—free from the impurities which are the sole cause of lowered lubricating efficiency. Naturally, then, turbines or other prime movers which operate continuously with such oil cannot fail to outlast and outperform units having less perfect lubrication.

Half-way measures are of doubtful value in this matter of oil purification. A little sludge, a little water, a few abrasive particles in the wrong place may do almost as much damage as a much larger quantity of impurities.

Repeated tests and several years of practical experience have proved that proper centrifugal purification effects a more complete removal of impurities from lubricating oil than any other commercial method. That is why more than 80% of America's greatest electric power systems use De Laval Oil Purifiers.

Write for Bulletin 106-P, which gives information relating to your own particular problem.

THE DE LAVAL SEPARATOR COMPANY

165 Broadway, New York 600 Jackson Blvd., Chicago

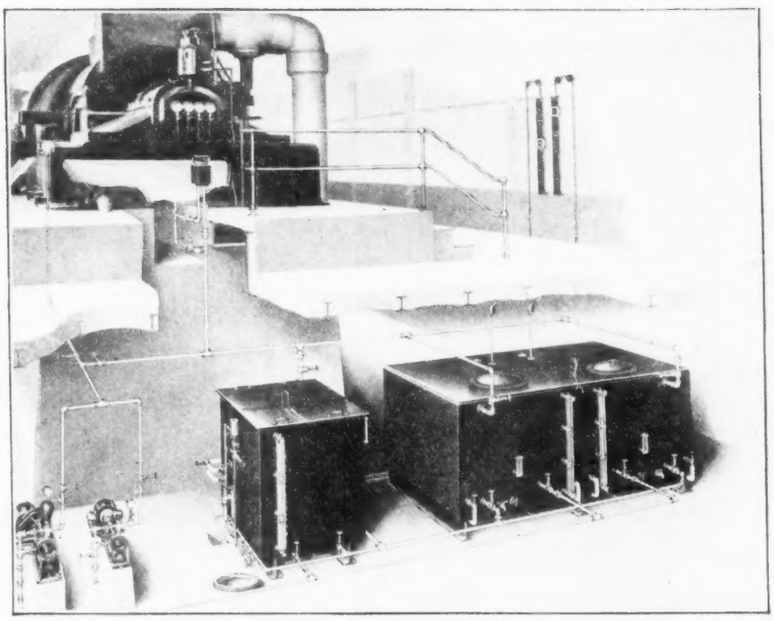
DE LAVAL PACIFIC COMPANY, San Francisco

ALFA-LAVAL CO. Ltd., 34 Grosvenor Road, London, S. W. 1

De Laval Oil Purifiers

Types for Lubricating Oil, Fuel Oil, Transformer and Circuit Breaker Oil, Crankcase Oil

BOWSER ESTABLISHED 1885



Month's oil consumption equals each minute's circulation

On a large wire rod mill, equipped with Bowser continuous oil purification system, 125 gallons of oil are circulated a minute, and kept continuously purified by the Bowser purifying equipment.

Monthly oil consumption is about 3 barrels—or only about what the system circulates per minute!

Full details of the Bowser Type C system, oil storage system, etc., may be had by addressing Dept. 6.

S. F. BOWSER & COMPANY, Inc.
LUBRICATION ENGINEERS AND MANUFACTURERS
FORT WAYNE, INDIANA, U.S.A.

LUBRICATORS—OIL FILTERS—OILING SYSTEMS—ACCESSORIES
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Insures Perfect Lubrication

Ohio Cylinder Grease
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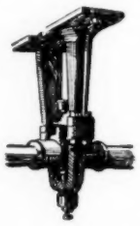
A complete line of industrial and automotive lubricants of exceptional quality. 89 kinds and consistencies. Let us show you how to get better lubrication for less money. No obligation.

Ask about our spare time agency proposition. It wont interfere with your regular work.

The Ohio Grease Co., Loudonville, Ohio.



USG

To Lubricate all kinds of machinery bearings

For general lubricating purposes you can be sure of the best results, by using

MEXICAN GRAPHITE CUP GREASE

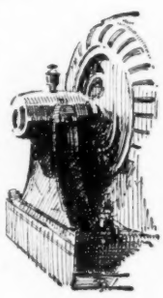
A combination of natural amorphous (not flake) graphite and a high quality grease derived from the best mineral oil. Made in four consistencies.

EXTRA SOFT—for high speed bearings, transmissions and sliding gears.

SOFT—Ideal for crank pins, crossheads, valve motions, eccentrics, slides, main journals, pillow blocks, etc. Will freely pass thru small holes and spring or compression lubricating cups.

MEDIUM—for use on open bearings and in screw or compression cups under high pressure.

HARD—for heavy open bearings, cams, spindles, etc.



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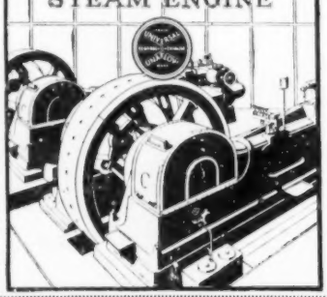
The United States Graphite Co.
Saginaw, Mich.

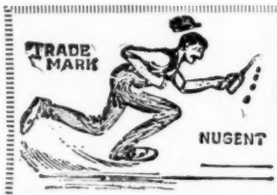
THE UNIVERSAL UNAFLOW STEAM ENGINE



The Most Economical Steam Engine

"UNIVERSAL UNAFLOW"

Built only by
Skinner Engine Co.
ERIE, PENNA.



THIS trade mark which you have seen upon the Nugent Oil Filters, Oiling Systems, Filtering Systems, Telescopic Oilers, Oil Pumps, Sight Feed Valves, etc., for the past 27 years, is the symbol of a nation-wide organization for the service of every ENGINE BUILDER and USER. Every POWER PLANT BUILDER and USER who wants to make OIL and ENGINES do more and better work.

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More than 10,000 in operation. Write for Catalog S-255 Also Reduction Gears Catalog S-175 and Flexible Shaft Couplings Catalog S-665
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Steam Turbine Co., Trenton, N.J.

Steam Turbines, for all speed and steam conditions. Catalog D40. Double Helical Speed Reducing Gears. Catalog G40. Centrifugal Pumps, for all capacities. Catalog B40. Centrifugal Blowers and Compressors. Catalog F40. Worm Reduction Gears. Catalog R40. Flexible Couplings. Catalog K40. Water Wheels.

LOMBARD DIESEL ENGINES 100 TO 600 H.P.

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Repairs to Power Plants

Emergency Repairs—Always Ready
Wire us your trouble. Instant Service

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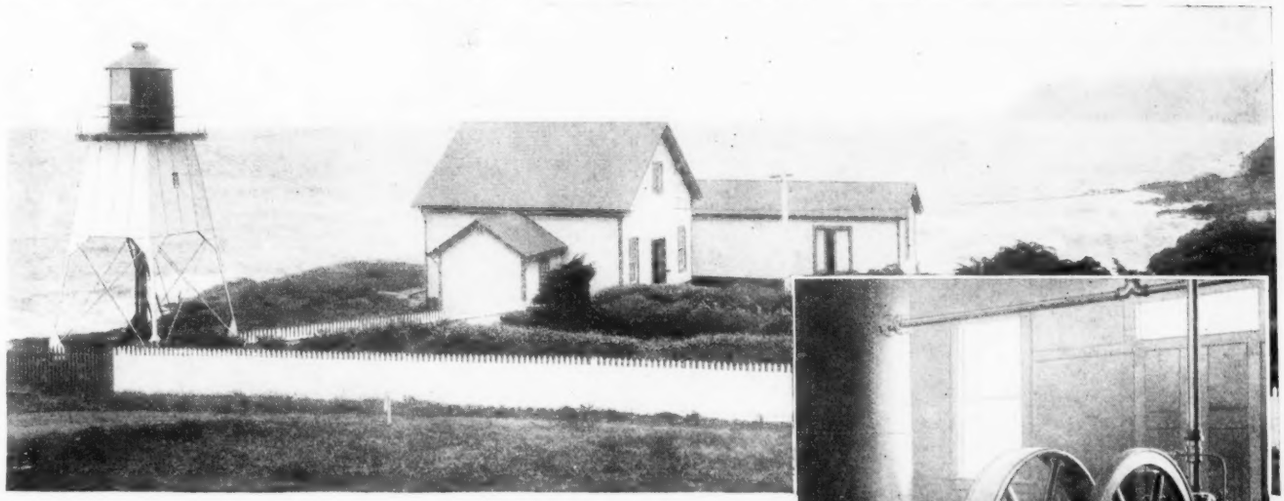
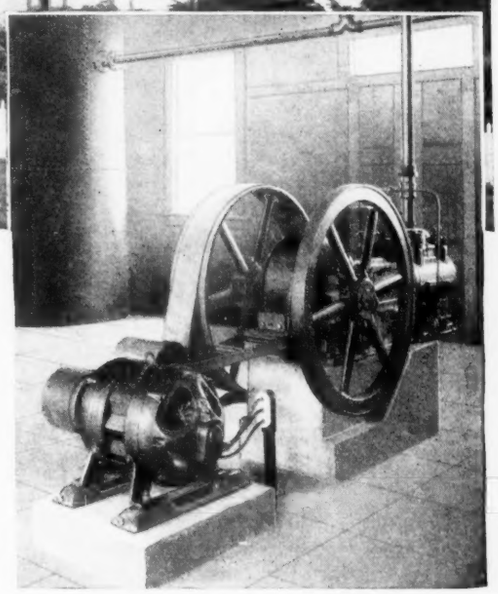
Established 1870 1015-1025 Hamilton St., Phila., Pa.

DEPEND ON SULLIVAN AIR POWER





Where Air Power Must Not Fail

LIGHTHOUSES at Point Bonita, Point Montara, and Point Hueneme, California, depend on Sullivan 9x8 "WG-6" Compressors to blow their fog signals. Although the service is intermittent, *it must not fail;* and sometimes the periods of constant service run as high as 18 to 20 hours.

At Point Bonita a type F Diaphone requiring 13½ cu. ft. of air per second, and a 6-in. air siren, using 30 ft. of air per second, are used. The Diaphone consists of a reciprocating device acting on a diaphragm on the order of an electric automobile horn, but using air as the actuating medium. Timing of the blasts is accomplished by a revolving wheel carrying cams which operate a tappet to admit air to the diaphragm. By proper placing of these cams, each station is given a characteristic signal.

Sullivan "WG-6" Compressors were selected for this service, for the same reason that they are selected by power plant engineers of every industry—because they are dependable. "WG-6's" are built in capacities from 68 to 500 cu. ft., are equipped with "Wafer" valves, positive automatic lubrication, and "sweep control" unloading, and have all working parts completely enclosed in dust-tight housings.

Let us send you Catalog 783-B

Above: View of lighthouse at Point Montara, and "WG-6" Compressor employed to blow foghorn. The diaphone here requires 20 cu. ft. of air per second, at 30 lbs. pressure. The pressure at which the air is delivered gives a distinctive tone to the blast.

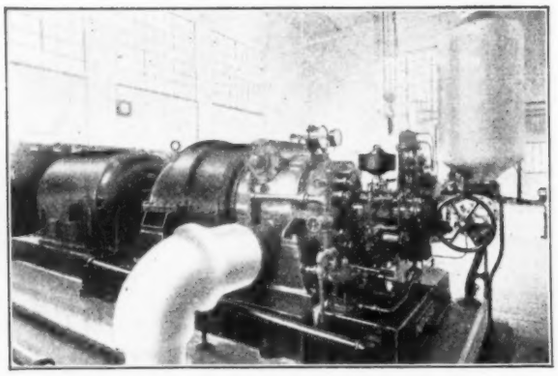
COMPRESSORS · AIR LIFT · COAL CUTTERS · DIAMOND CORE DRILLS · ROCK DRILLS
PORTABLE HOISTS · DRILL SHARPENERS AND FURNACES · BUSTERS · SPADERS

SULLIVAN (TRADE MARK)
MACHINERY COMPANY
132 SOUTH MICHIGAN AVENUE, CHICAGO

From the Sullivan Line

THE "TURBINAIR" HOIST weighs only 345 lbs., but will lift a ton at 110 ft. per minute, or pull a 50-ton car on level track. Use it for spotting cars, pulling coal scrapers, or for handy hoisting around your plant. Catalog 776-F.

MOORE



Moore 1,000 kw. Bleeder Type Turbo Alternator Unit installed at Municipal Plant, Valley City, N. D.

8 Months

Without a stop and still running

Municipal service cannot fail, therefore, Valley City, N. D. chose Moore — Mr. Bergman, Superintendent, writes:

"Regarding the 1000 KW Moore bleeder type condensing turbine which we installed in our plant in 1925, you may be interested in knowing that this machine has now made a non-stop run since the 17th of September, 1926, and at the present time there are no indications of the necessity of any shut down in the near future."

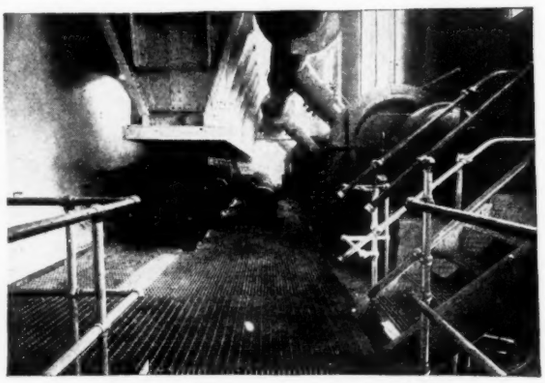
For continuous and economical operation specify Moore. Incidentally, steam is bled from this unit during winter months for heating the business district and current is produced as a by-product at a very low cost.

Steam Turbines *Centrifugal Pumps*
Reduction Gears

OFFICES IN ALL PRINCIPAL CITIES

MOORE STEAM TURBINE CORP.
Wellsville, N. Y.

GRATING and TREAD



REFINED EQUIPMENT

The production of super-power in these days of keen competition can only be accomplished by the utilization of equipment which has been refined to the point of extreme excellence.

For an accurate fit, ease of installation, complete ventilation and "foot-safety" investigate—

TRI-LOK

Ventilated Steel Flooring

THE TRI-LOK COMPANY 5519 BUTLER STREET PITTSBURGH, PA.

Falls Engine Stop

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Natural Gas and Blast Furnace Gas Burners
GAS COMBUSTION CO., Pittsburgh, Pa.

TROY ENGINES

are designed and built for heavy duty in driving stokers, fans, pumps and generators. Entirely enclosed. Automatic lubrication. Capacities to 200 brake horsepower. Write for catalog.

ONLY STEAM ENGINES GOOD ENGINES ONLY

Troy Engine & Machine Co.
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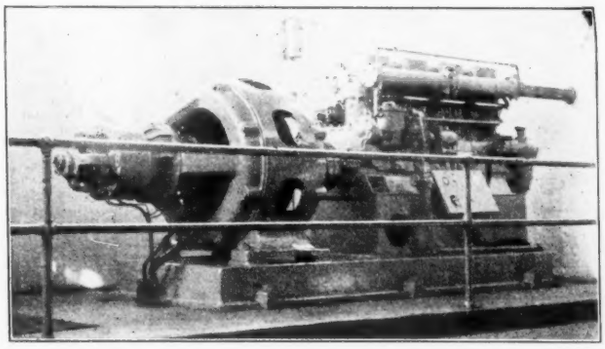
Sterling
High Duty
Gas and
Gasoline
Engines



Xenia, Ohio, 8 cylinder, 240 H.P., Sterling Engine driving 120 KW, 60 cycle generator, 1200 R.P.M.

EMERGENCY POWER

When your main power fails you can start a Sterling Engine instantly. Operating cost is less than maintaining fire under a steam boiler of similar power.

They cost about $20.00 a horsepower.

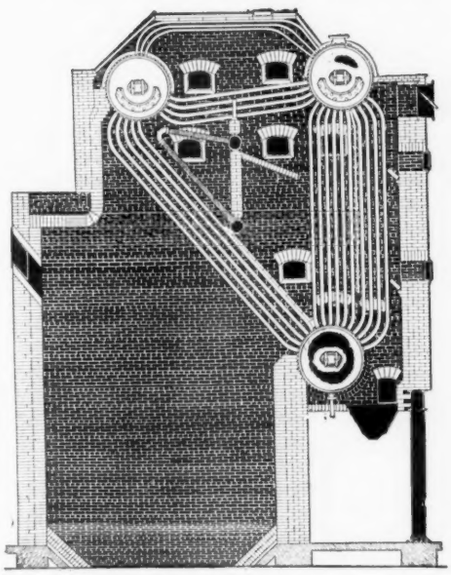
There are 550 cities and manufacturing plants protected by Sterling Engines.

STERLING ENGINE COMPANY, Dept. C-1, Buffalo, New York

WICKES THREE DRUM BOILERS

Attention is requested of boiler users and engineers to the new Wickes Three-Drum Boiler. This boiler is particularly adapted to the requirements of modern industrial steam power plants. Our Sales Engineers will gladly describe the advantages of the new Wickes Three-Drum Boiler.

1. Integral Superheater
2. Positive Circulation
3. Simple In Design
4. Accessible
5. High Pressure
6. High Ratings
7. Economy
8. Wickes Workmanship



Descriptive Literature Mailed on Request.

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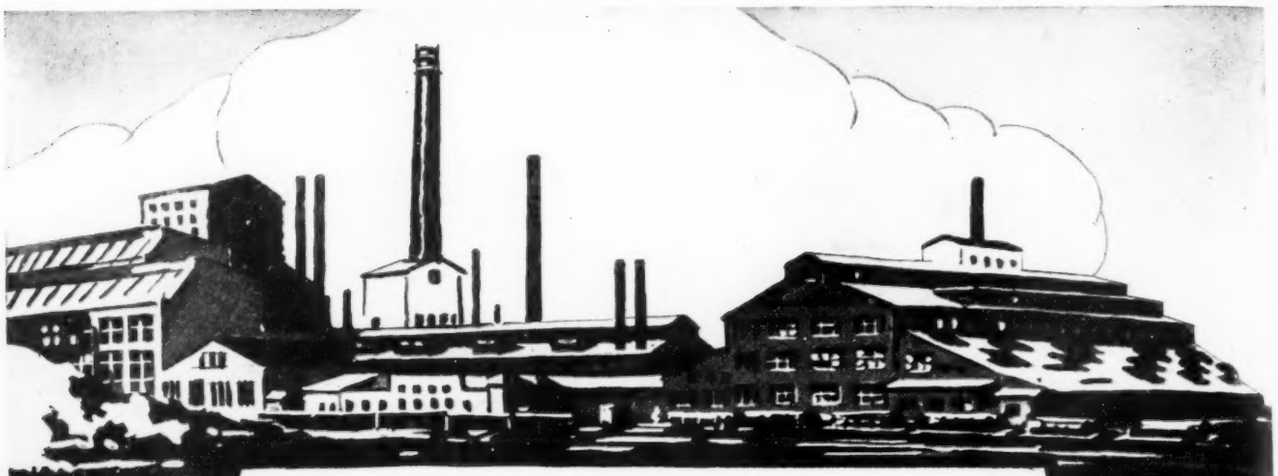


45 Years of Boiler Building

¶ Every Heine Boiler built today has a heritage of 45 years experience in the manufacturing of water tube boilers.

¶ The strength and resources of this company have recently been supplemented and the scope of the organization has been correspondingly extended.

¶ The Heine Boiler Company is now a subsidiary of International Combustion Engineering Corporation.

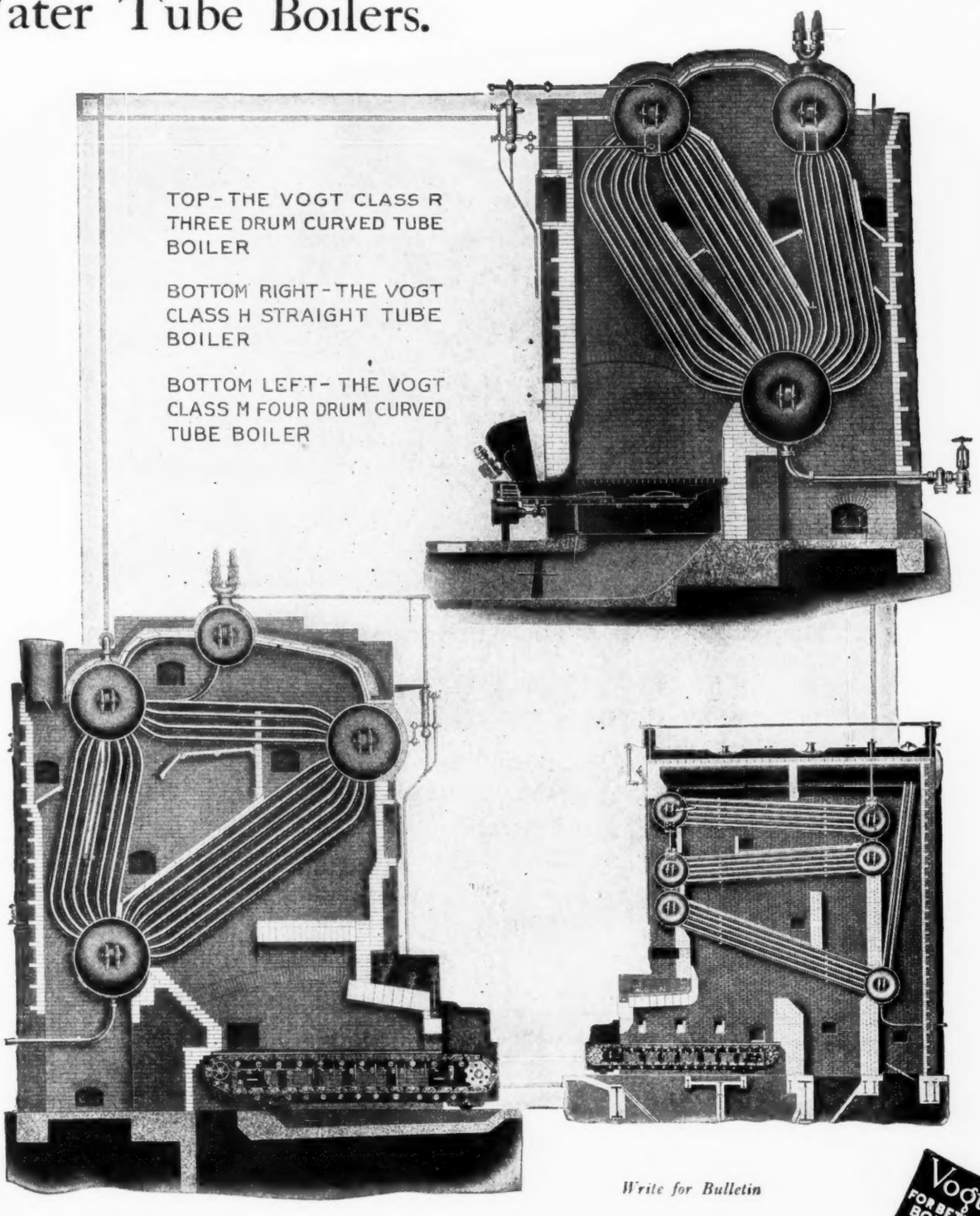
HEINE BOILER COMPANY

International Combustion Building
200 Madison Ave., 35th to 36th St., New York

A SUBSIDIARY OF INTERNATIONAL COMBUSTION ENGINEERING CORPORATION

Heine Boilers

Every requirement for efficient steam generation is included in the various designs of Vogt Water Tube Boilers.



TOP - THE VOGT CLASS R THREE DRUM CURVED TUBE BOILER

BOTTOM RIGHT - THE VOGT CLASS H STRAIGHT TUBE BOILER

BOTTOM LEFT - THE VOGT CLASS M FOUR DRUM CURVED TUBE BOILER

Write for Bulletin

HENRY VOGT MACHINE CO., Inc.

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Manufacturers of Oil Refinery Equipment, Drop Forged Steel Valves and Fittings, Water Tube and Horizontal Return Tubular Boilers, Ice Making and Refrigerating Machinery.

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Builders since 1868 of Water Tube Boilers of continuing reliability

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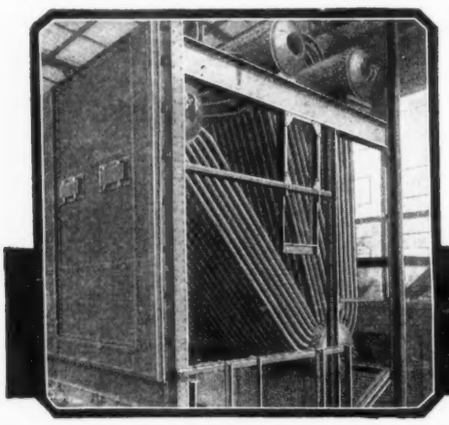
SAN FRANCISCO, Sheldon Building
LOS ANGELES, Central Building
SEATTLE, L. C. Smith Building
HAVANA, CUBA, Calle de Aguiar 104
SAN JUAN, PORTO RICO, Royal Bank Building



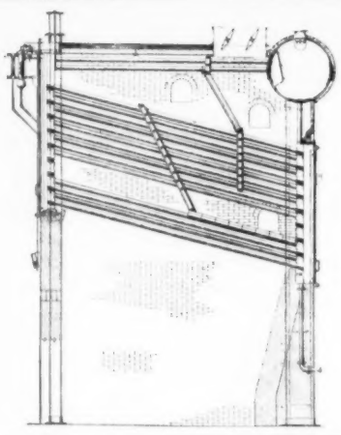
Rapid, Definite, Unrestricted Circulation

ELIMINATES steam pockets which cause the burning out of tubes—prevents unequal expansion. It's one of the many reasons why Connelly Boilers are economical of operation. A fully descriptive catalog will be mailed promptly on request.

Built in units from 200 to 4300 H. P. and for steam pressures up to 450 lbs.

50 Years Knowing how!

The CONNELLY BOILER COMPANY 1170 Ivanhoe Rd. Cleveland, Ohio



Seamless Forged Steel

Sectional Header Boilers

Especially suited to high pressures and large size units.
Adaptable to all fuels.

Pressures up to 650 lbs. Sizes up to 30,000 sq.ft.

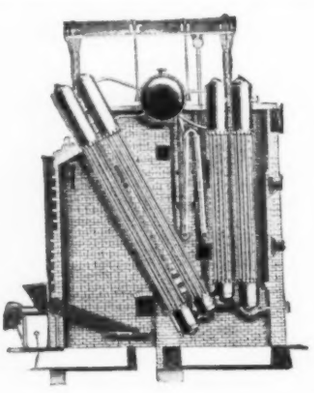
Water Walls Vertical Bent Tube Boilers

Write us now for prices.

THE WALSH & WEIDNER BOILER CO.

Chattanooga, Tenn.

New York, Memphis, New Orleans, Greenville, S. C., Kansas City, San Francisco, Houston, Tex., Chicago, Havana, Cuba, Honolulu, H. T.



BIGELOW-HORNSBY WATER-TUBE BOILERS

For over fifty years, we have been manufacturing steam boilers. We are the oldest and largest manufacturers of boilers in the New England States and have established a reputation of unexcelled workmanship and material; always striving to improve our product in every possible way, and having a plant equipped throughout with most modern up-to-date machinery.

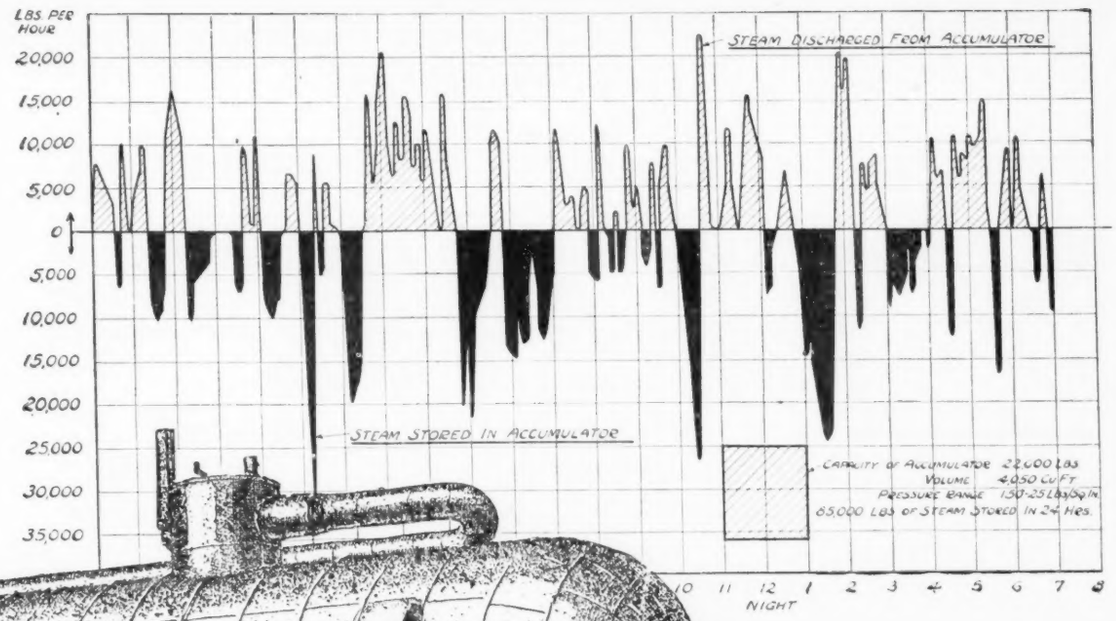
Also Manufacturers of

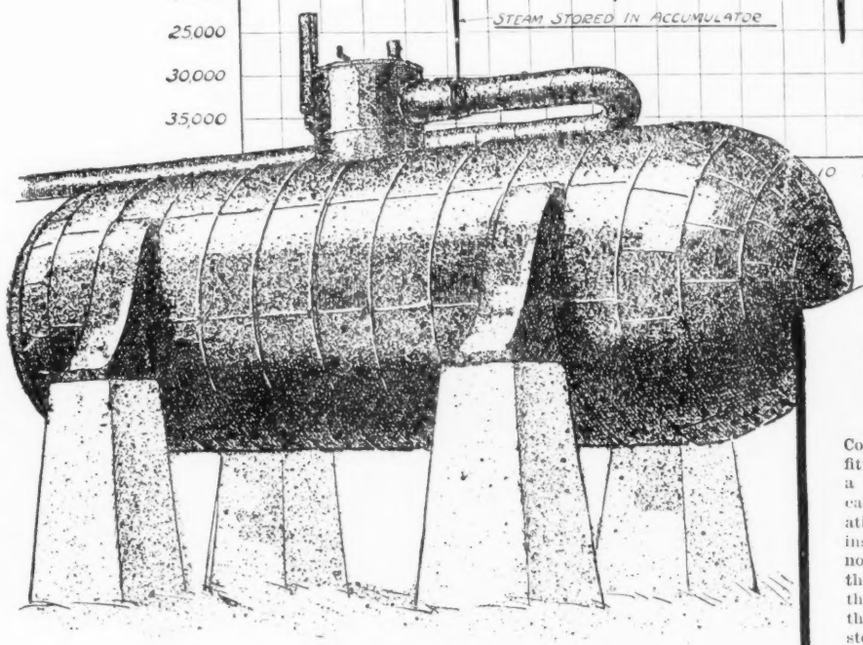
The Bigelow Horizontal Return Tubular Boiler

The Bigelow-Manning Boiler The Bigelow Two Pass Boiler

THE BIGELOW COMPANY, 68 River St., New Haven, Conn.

NEW YORK PHILADELPHIA BOSTON





Smooth out your boiler load curve into a flat constant load line

It can be done with the aid of a RUTHS STEAM ACCUMULATOR, which will provide additional water storage space outside of the boilers to absorb excess steam during light load periods and which will evaporate the stored hot water under pressure into steam at a rate which will immediately meet a sudden increased demand for steam, which is above the momentary steaming rate of the boilers.

Uniform steam output per boiler under a variable load may therefore be maintained.

Ruths Automatic Regulating Valves

will maintain the steam pressure to auxiliaries heating and process lines constant.

Write us for full technical information.

Ruths Accumulator Co., Inc.
292 Madison Ave., New York

The Ruths Steam Accumulator

Consists of a cylindrical steel tank, fitted with hemispherical ends, and of a volume which is determined specifically by the boiler capacity and operating conditions for which it is to be installed. Internal steam charging nozzles and circulating pipes insure the uniform and noiseless heating of the water. Non-return valves control the charging and discharging of the steam. Ruths oil pressure actuated regulating valves maintain a constant pressure on all lines served by the accumulator.

Advantages

Reduces fuel consumption
Reduces boiler maintenance.
Reduces initial cost of new boiler plant.
Maintains constant steam pressure.
Maintains uniform quality of product.
Increases steam generating capacity.
Increases production.
Simplifies boiler control.
Can be utilized as a positive and efficient de-superheater.

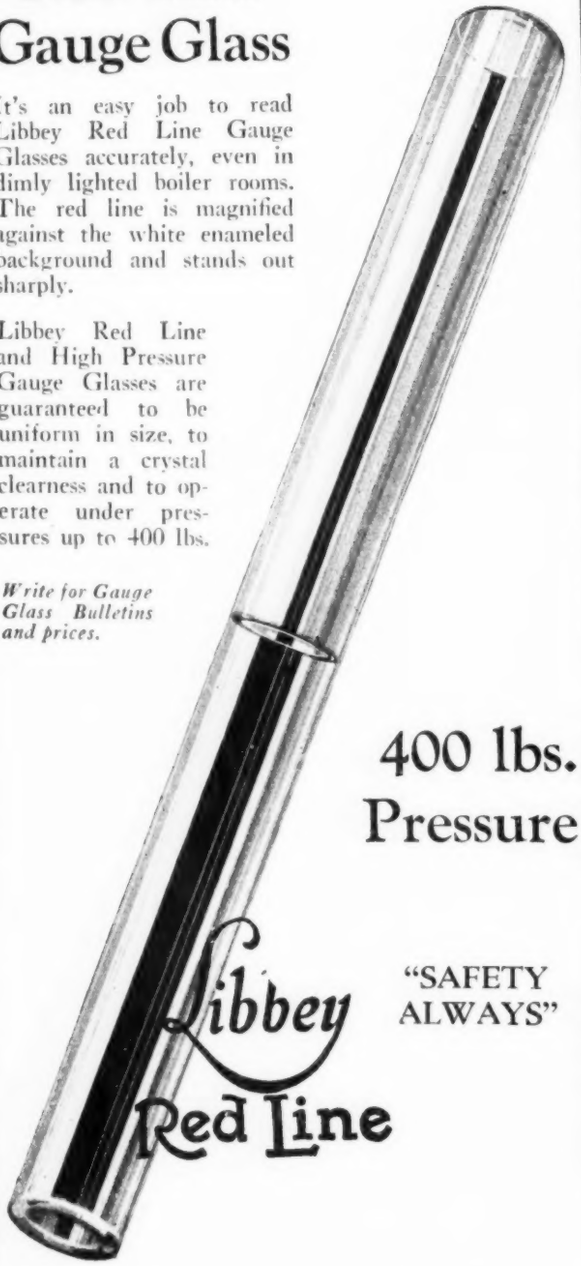
RUTHS STEAM ACCUMULATOR

Boiler Readings stand out clearly with LIBBEY Red Line Gauge Glass

It's an easy job to read Libbey Red Line Gauge Glasses accurately, even in dimly lighted boiler rooms. The red line is magnified against the white enameled background and stands out sharply.

Libbey Red Line and High Pressure Gauge Glasses are guaranteed to be uniform in size, to maintain a crystal clearness and to operate under pressures up to 400 lbs.

Write for Gauge Glass Bulletins and prices.



400 lbs. Pressure

"SAFETY ALWAYS"

The Libbey Glass Mfg. Co.

Manufacturers of Railroad and Industrial Glassware

Toledo, Ohio

UNION

Water Tube Boilers

HIGH overload capacity coupled with quick steaming factors enable Union Water Tube Boilers to cope with peak demands.

The simplicity of their construction assures easy cleaning. Tube scaling is minimized, due to the self-contained feed water purifier.

UNION IRON WORKS

1500 Cascade St., Erie, Pa.

Established 1890

For medium and high pressures

ESPECIALLY suitable for large power plants. Steel construction throughout. Straight tubes. All handholes elliptical, their covers internal and removable through their own openings. Unrestricted circulation, permitting forcing of fires with safety and economy.

Send for bulletins on performance

EDGE MOOR IRON COMPANY Edge Moor, Delaware

EDGE MOOR Water Tube BOILERS

FOR INCREASED FUEL ECONOMY

The Casey-Hedges

MULTIPASS

Water Tube

BOILER

The best boiler for high efficiencies, high ratings and bad water.

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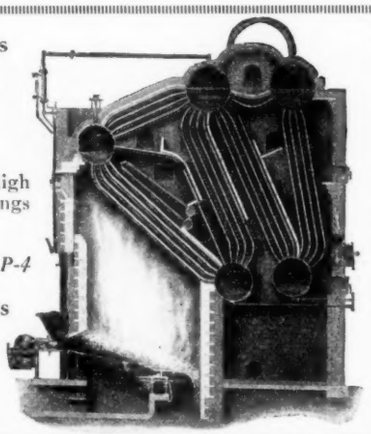
The Casey-Hedges Company

Chattanooga, Tenn.

Representatives in all principal cities



SPRINGFIELD BOILERS

WATER TUBE BOILERS

SECTIONAL

ALL STEEL

Springfield Boiler Co.

Springfield, Ill.

LADD BOILERS

INTERNATIONAL COMBUSTION ENGINEERING CORPORATION

Ladd Water Tube Boiler Co.

International Combustion Building

200 Madison Ave., 35th to 36th St., New York

First National Bank Building, Pittsburgh

A Subsidiary of International Combustion Engineering Corp.

K.W.S.

REG. U.S. PAT. OFF.

SODIUM ALUMINATE

You don't guess when you use K.W.S.

INTERNAL treatment of boiler feed water has always been guesswork—educated guessing in some cases but usually just blind hit or miss guessing. A water analysis might be made when a boiler compound or uncompounded chemical was prescribed. But after a short period of relief, the water would change, the treatment would be "off," and the engineer would find conditions getting worse and go back to the old process of guessing.

K.W.S. sodium aluminate has stopped the necessity for guessing about the condition of your boiler feed water. A simple scientific method developed by this company and furnished to every user of K.W.S. raises internal treatment to the same level of scientific accuracy as is found in the external treatment plant. This company not only shows an operating engineer how to determine water conditions—it checks up regularly by mail and by service men's calls to see that K.W.S. is being used to produce the results of which it is capable.

This is revolutionary practice in water softening, but it is practice that means tremendous savings to power plants. Many of the country's largest industries have proven the truth of this statement.

A copy of our catalog on water testing equipment will be of interest and value to every man concerned with boiler operation. A copy will be sent gladly on request. To enable us to supply information of the most direct value to you, please give your company name and state whether interested in external or internal treatment.

You Got Us Started Right

"We appreciate the attention given by your company in order to get us started right. We will continue to use your product."

Your Instructions Have Produced Results

"We have continued using K.W.S. according to your instructions and the results so far are satisfactory. In the last boilers inspected, we have noticed no new scale forming."

Your Representative Is Exceptional

"Your representative who has been visiting our plant periodically since your product was installed is an exception to the average salesman who visits us. You should be complimented on having a man of his ability and personality."

Our Success Has Been Through Efforts of Your Man

"We have been getting good results with K.W.S. and can heartily recommend it to anyone else. Quite a bit of our success with K.W.S. has been through the efforts of your representative."

Cut Down Treatment As Per Your Man's Instructions

"After using your K.W.S. in our boilers as instructed by your chemist for the last ninety days, I am glad to say we have had good results as the boilers are clearing up in fine shape and we have cut down our treatment as per your man's instructions."

Cut 19 grains to ½ grain

"We are obtaining satisfactory results from the use of K.W.S. The raw water here runs 19 grains hard. We were formerly treating it down to 5 grains. We are now running it about ½ grain hard with K.W.S."

Able To Check What We Are Doing

"We are much pleased with the results from K.W.S. in our boiler. We have reduced the hardness to a minimum and with your small testing equipment we are able to get a check on what we are doing."

K.W.S. Did Just What You Said It Would

"Your sodium aluminate did just what your representative said it would. Our boiler water tested zero when he last called and the old scale can be washed from the tubes, whereas we formerly scraped it."

CHICAGO CHEMICAL CO

WATER TREATING AND CLARIFYING ENGINEERS

6222 W. 66th Place

CHICAGO

Specialists in water softening, filtration, process work, waste water disposal, and all problems involving water supply and treatment.

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Plant of the Vacuum Oil Co., manufacturers of "Gargoyle" lubricants, Paulsboro, New Jersey. One of 2,000 plants using K.W.S. sodium aluminate.

P6-28Gray

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Manufacturers of

SEAMLESS STEEL TUBES

THE BABCOCK & WILCOX TUBE CO.

For Stationary, Locomotive and Marine Boilers

For over twenty years, the Company's mills have been making high grade tubes for Babcock & Wilcox boilers. The same careful selection of raw materials, close supervision of manufacture and rigid final inspection are followed whether the tubes are made for Babcock & Wilcox boilers or for any other purpose.

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Pittsburgh, Farmers Deposit Bldg.
Boston, 80 Federal Street
Chicago, Marquette Bldg.
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For Boilers

Charcoal Iron *Lap Welded Steel*

Large stocks of standard boiler tubes carried in our warehouses assure prompt deliveries throughout the United States. Every attention given special orders.

Write for further details.

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WASHINGTON, PA.

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Special Representatives: W. M. MacCleary, 2 Rector Street, New York City; W. H. S. Bateman & Co., Philadelphia, Pa.

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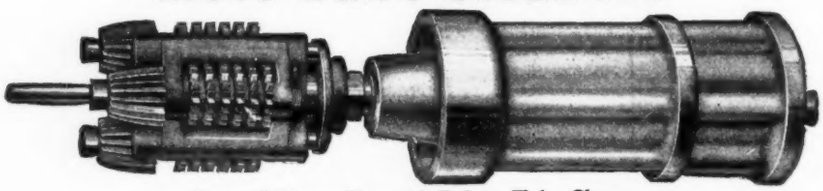
Save Time and Expense in Boiler Cleaning

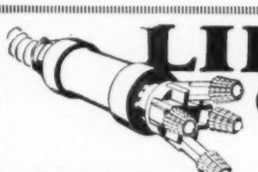
By cleaning as often as possible—instead of only when you must

Roto Tube Cleaners



Roto 4" Heavy Duty Air-Driven Tube Cleaner

THE ROTO COMPANY, Sussex Ave. and Newark St., NEWARK, N. J.



LIBERTY CLEANERS

for all sizes and types of tubes

LIBERTY MFG. CO., JEANNETTE, PA.

KINGSFORD

All Steel Sectional Water Tube Boilers

A design and construction that has proved its high efficiency under all steaming conditions. Also builders of horizontal and vertical Unaflow Engines and all types of Centrifugal Pumps. Write for Catalog.

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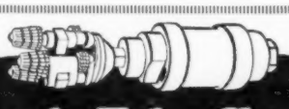

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Tube Cutters, Reseating Machines

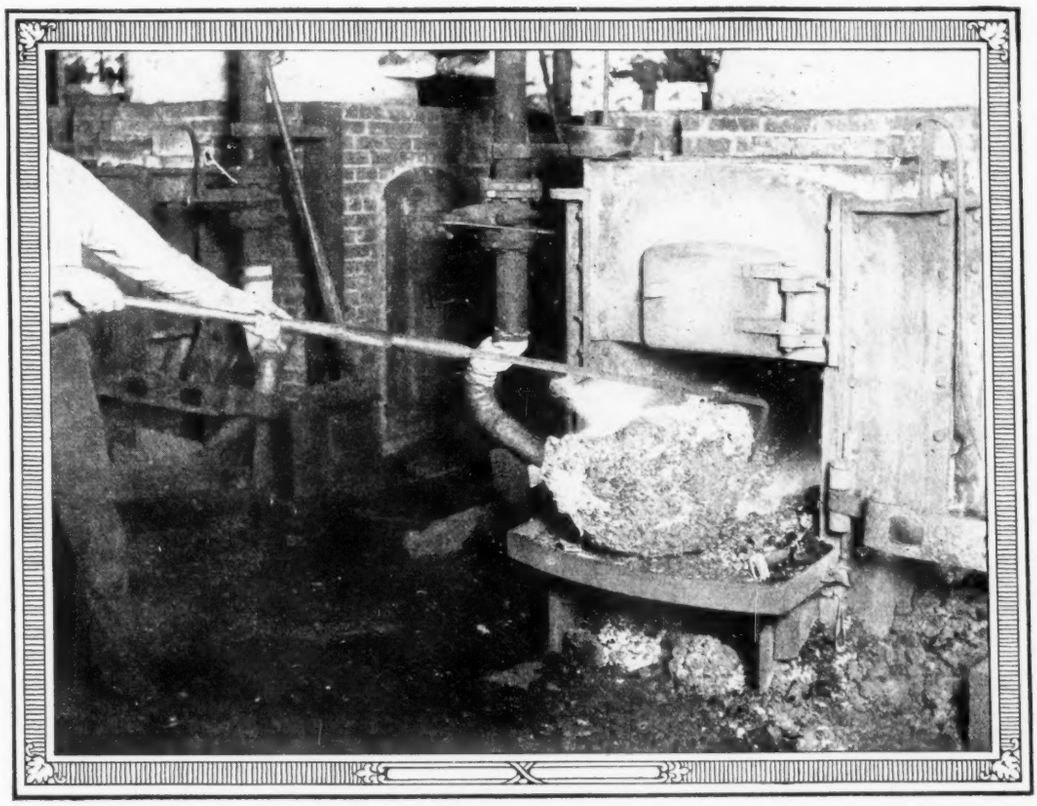
The LAGONDA MANUFACTURING CO., SPRINGFIELD, O.

MAGIC BOILER PRESERVATIVE

"The Pioneer Boiler Treatment"

Positively removes and prevents scale, stops leaks, pitting and corrosion

GARRATT-CALLAHAN CO.
San Francisco Chicago New York



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QUALITY in Charcoal Iron Boiler Tubes begins with the efficient operation of the forge or knobbling furnace. Here the base metal is subjected to the action of burning charcoal and cold-air blast, which slowly melts it, eliminating impurities and leaving a lump of commercially pure charcoal iron.

Every pound of base metal which enters the knobbling furnaces in Reading's million-dollar Tube Mill must meet the most rigid requirements. And the men who operate the furnaces are selected for their long experience and unerring accuracy in this exacting work.

Reading Charcoal Iron Boiler Tubes represent the best that the finest men, machinery and materials can produce.

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"The Unbreakable Gauge Glass"

Why take a chance where safety is at stake? Unaffected by extreme pressure or rapid temperature changes, SONDERGLASS insures safety to operators and, in addition, *economy of operation.*

Reflecting Type Gauge Glass

Where visibility is poor and accurate reading essential, use the reflecting type SONDERGLASS. It's *easy* to read!

A. W. CHESTERTON COMPANY
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Quick opening—self-closing, insurance against scalds!

The "P.B.H." High Pressure Gauge Cock

Suitable for 1000 lbs. Pressure

Pat. App. For

Monel Metal Seat and Stem

"PBH" High Pressure Gauge Cocks are quick opening, self-closing and resemble the "PBH" regular pressure cock (thousands of which are now in use) in design and workmanship. They are much heavier in construction and have the added feature of renewable monel metal valve seat and stem.

"PBH" high pressure cocks will not leak and they outlive the boiler in many cases. Renewing valve seat or stem is an easy operation and does not require removing cock shank. Renewals require little time and expense.

They are made in both right and left hand patterns in ½ in. and ¾ in. sizes, polished brass, with japanned iron weight. Suitable chains furnished on request.

Write now for details and prices.

We will furnish one or a set of three cocks for a reasonable trial.

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SOOT BLOWERS
STOKERS
GRATES

Save the coal

MARION MACHINE FOUNDRY & SUPPLY CO.
MARION, INDIANA

Diamond
AUTOMATIC VALVED
SOOT BLOWERS

Save 1 *carload of coal out of* 16

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APEXIOR
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—an accepted protective coating for hot water and steam surfaces of boiler plant equipment

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THE DAMPNEY COMPANY
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MAIN OFFICE DU BOIS PA. OFFICES IN THIRTY CITIES

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Soot Cleaners For All Types of Water Tube and Return Tubular Boilers, Super-Heaters and Economizers.

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Curved or Straight—Immediate Delivery
Boiler Tube Co. of America
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Speer E-24 brushes are giving the Interborough Rapid Transit Company entire and absolute satisfaction on Westinghouse 4000 K.W. rotaries in three sub-stations. Approval follows a year of service and is based on uniform wear, good commutation, quiet operation and low cost per rotary hour.

You, too, can have these proven Speer advantages. Speer Data Forms make it easy to analyze the factors which determine the brushes best for your use. Write for a set and see.

SPEER CARBON COMPANY
Saint Marys, Pa.

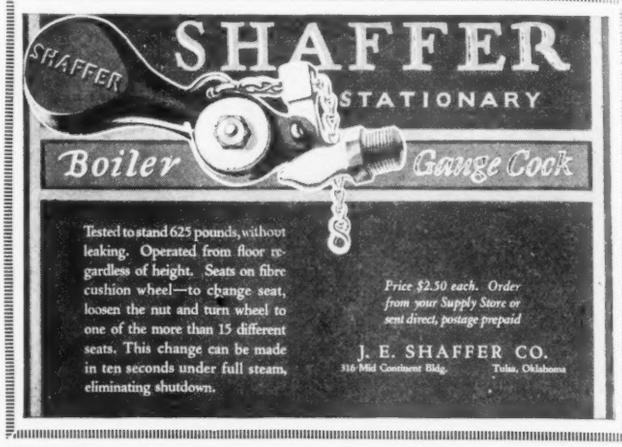
1791

Any Coal Will Burn More Freely—

when it is burned on Cyclone Grate Bars. They are especially designed for burning the lower priced coals smokelessly and to get more heat out of good or bad fuel. Proper spacing of the bars prevents losing good fuel into the pit during the shaking movement. Bulletin gladly sent on request.

CYCLONE GRATE BAR CO.
13 Grimes St., Buffalo, N. Y.

GRATES



Tested to stand 625 pounds, without leaking. Operated from floor regardless of height. Seats on fibre cushion wheel—to change seat, loosen the nut and turn wheel to one of the more than 15 different seats. This change can be made in ten seconds under full steam, eliminating shutdown.

Price $2.50 each. Order from your Supply Store or sent direct, postage prepaid

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WATER SOFTENERS & FILTERS
Hot — Cold — Intermittent — Zeolite; Pressure — Gravity
Complete Engineering Service
GRAVER *Corporation* Founded 1857
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WHY ARE MORSE SHAKING AND DUMPING GRATES BETTER?

THEY NEVER WARP—the clips are curved to allow for expansion and contraction. Grooved on top to allow ashes to act as an insulator and non-conductor for metal. 68% of available air is evenly distributed throughout the fuel. Catalog on Request. (See "AD" in April 12th issue)

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GREEN'S FUEL ECONOMIZERS

They will save from 10 to 15 per cent on your coal bill by recovering a large part of the heat now being wasted up your stack.

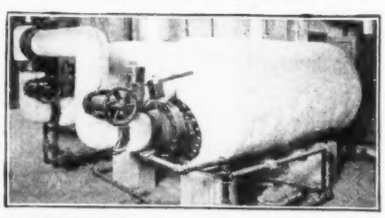
Millions of boiler horsepower to prove this saving. Get all the facts.

THE GREEN FUEL ECONOMIZER CO.
BEACON, N.Y.

For Hot Water—

Whether your need is for feed water, a heating system or a manufacturing process or a domestic purpose—the cost will be less if you heat the water in

ALBERGER-BUFFALO Heaters



Scientifically designed for high heat transfer, with Helically corrugated copper tubes. Divided floating tube head that eliminates expansion stress. Consult us on your requirements. **Write.**

ALBERGER HEATER CO., HOWARD IRON WORKS
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Ljungström AIR PREHEATER

Recovers 70% stack heat, raises CO_2, improves combustion—*Bulletin on request.*

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GRATES AND STOKERS
Shaking and Dumping Types Hand-Operated
Send for bulletins
Neemes Foundry, Inc., Troy, N. Y.

ECONOMIZERS
For all types and sizes of boilers

UNIT COAL PULVERIZERS

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POWER SPECIALTY CO., 111 Broadway, New York
Boston Philadelphia Pittsburgh Cleveland Detroit Chicago Milwaukee
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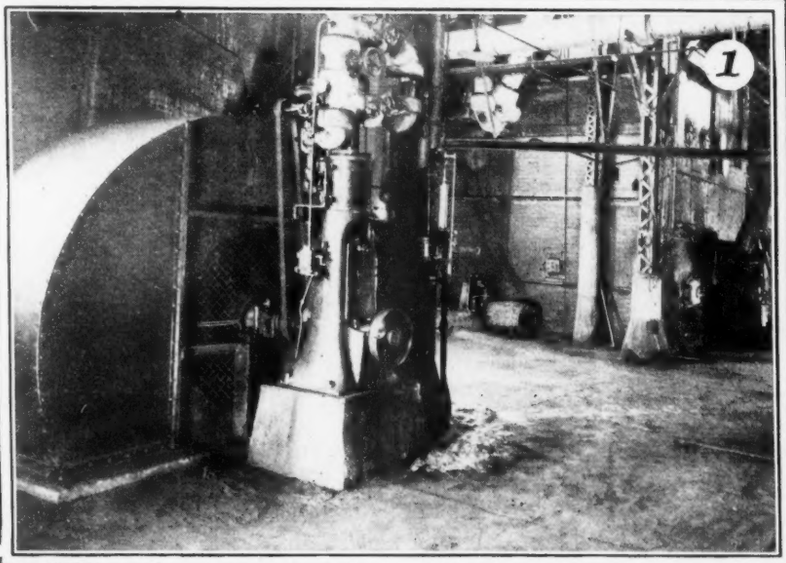
SUPERHEATERS
Complete installations designed and erected

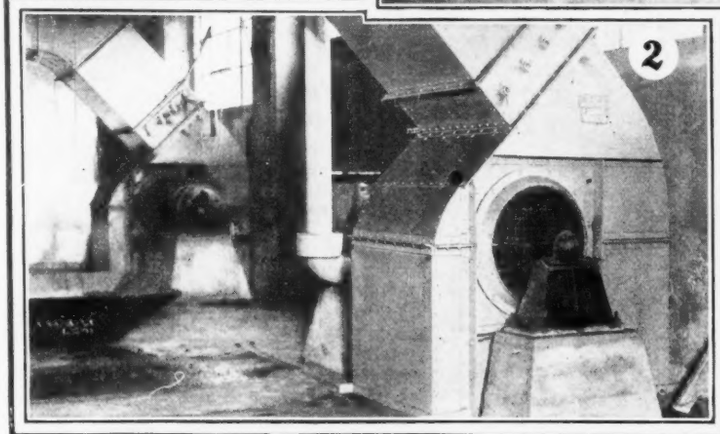
WATER-COOLED FURNACES

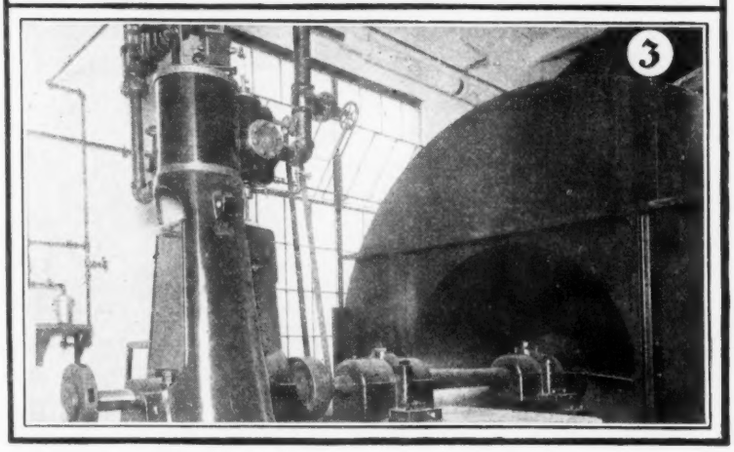
No. 1 Size of 140 Type R Forced Draft Blower direct driven by 8¾ x 7 Clarage Steam Engine, furnishing draft for Combustion Engineering Corp. stokers at Nash Motors, Kenosha, Wis. More than 1200 Type R Units are now in service.

No. 2 Two size 2½ Type FD High Speed, direct turbine and motor driven Blowers, servicing Detroit Underfeed Stokers at Fred B. Stearns Co., Detroit, Mich. This equipment is new and incorporates many outstanding advantages.

No. 3 Size 210 Type I Induced Draft Fan direct driven by 9 x 9 Clarage Engine, supplying draft to boilers at Kalamazoo Vegetable Parchment Co., Kalamazoo, Mich. Note generous size of bearings and heavy, sturdy construction.







Regardless of Your Requirements We Are Prepared

CLARAGE knows mechanical draft in all its ramifications. When you come to this Company with your draft problem, you have placed it in capable hands.

Our facilities are adequate; Clarage equipment is built in types and sizes to meet every possible need; Clarage engineers are thoroughly conversant with every possible application, as the result of wide practical experience and an extensive knowledge of actual field conditions. Regardless of your requirements we are prepared to serve you—and serve you well.

We suggest that you allow a Clarage engineer the opportunity to submit a detailed recommendation and cost estimate covering your plant. There will be no obligation.

CLARAGE

CLARAGE FAN COMPANY, Kalamazoo, Michigan

Sales Engineering Offices in Principal Cities as follows:

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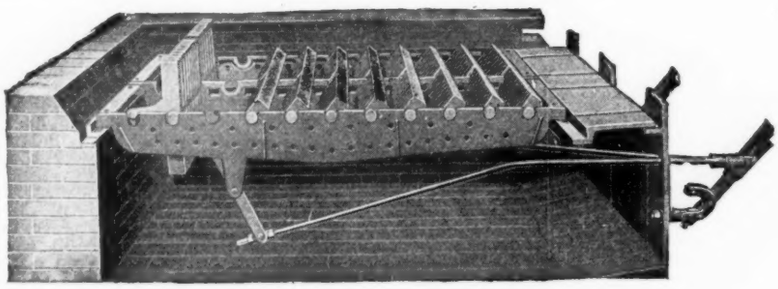
Mechanical Draft Equipment of All Types

KELLY GRATES GOSHEN IND.

Rocking and Dumping Grates



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Fuel that goes into the mouth of a furnace should never be returned through the fire door after it has performed the function of producing heat. Furnaces, just like any other systems in which the principle of circulation is used, cannot function at their greatest efficiency with material moving in more than one direction. Kelly Rocking and Dumping Grates for small and medium sized plants eliminate the necessity of forward cleaning by its powerful rocking grate and the 18-inch-wide rear dump.

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Clements
Cadillac
PORTABLE ELECTRIC
BLOWER

Removes dust and dirt from electric windings with blast of *dry air*. Correct pressure for this service prevents shorts and burnouts. Reduces fire risk and maintenance cost. Hundreds of uses in power plant or factory. Norma Ball Bearings; no oiling. Write for descriptive folder and trial offer.

CLEMENTS MFG. CO.
629 Fulton Street, Chicago, Illinois

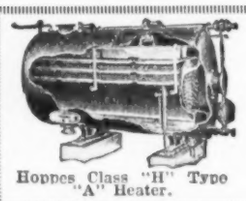
Increased Boiler Rating With Low Priced Fuel

A result of Coppus Forced Draft Blowers

DO NOT CHANGE YOUR CHIMNEY OR PUT IN ANOTHER BOILER BEFORE READING BOOKLET NO. 145.

REGISTERED COPPUS U.S. PAT. OFFICE ENGINEERING CORPORATION
350 PARK AVE. WORCESTER, MASS.

CENTRIFUGAL TURBO BOILER FEED PUMPS • STEAM TURBINES • MINE VENTILATING BLOWERS



Hoppes Class "H" Type "A" Heater.

A large heater in a small space

Catalog No. 85 tells about the full line

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for mechanical draft heating and ventilating
Buffalo Forge Co.
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Protect Your Crushers
KEEP OUT TRAMP IRON WITH THE ACME MAGNETIC PULLEY
standardized separation
THE ACME MAGNETIC PULLEY CO.
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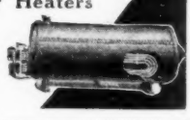
Hot Water and Feed Water Heaters
Thousands in use. Backed by 45 years' experience. Guaranteed.
Write for catalog.



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DETROIT UNDERFEED STOKERS

Ask For Bulletin 879

Detroit Stoker Company
879 General Motors Bldg - Detroit.

HAGAN CORPORATION

Combustion and Chemical Engineers

Specialists in Combustion Control and Boiler Water Conditioning

Bowman Bldg., 3rd & Ross Sts., PITTSBURGH, PA.

SMOOT CONTROL

A complete system—for machine regulation of any number of boilers from one central point. Many prominent installations.

Smoot Engineering Corporation
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Leaders in Modern Combustion Control

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The FORCED DRAFT travelling grate stoker with 7 improved features you should know about. Send for Bulletin 11 to Rosedale Foundry & Machine Co., Columbus and Preble Ave.'s Pittsburgh, Pa.

The results obtained burning low grade screenings on

LACLEDE CHAIN GRATE STOKER

COMMAND YOUR ATTENTION

Write for Particulars

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Mettler Entrained Combustion Gas Burners

FOR ALL Purposes Kinds of gas Pressures

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The AUBURN STOKER

Hand Fired Semi Automatic Full Automatic

AUBURN STOKER CORPORATION
607 HARTFORD BUILDING CHICAGO

A COMPLETE STOKER

The ARMSTRONG STAIR STEP STOKER embodies in itself everything necessary for the complete and perfect combustion of coal.

It provides a positive method of opening every air space without the loss of any good coal into the ash pit.

It insures feeding of coal at a rate to meet varying steam requirements.

Coal is carried gradually down over the stoker through progressive stages of combustion, assuring a hot, clean fire.

High overratings — unusual economy — remarkable efficiency is insured where this stoker is used.

Grates
Hand Stokers
Mechanical Stokers
Gasoline Locomotives
Grey Iron Castings
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(Agents Wanted)

Armstrong Manufacturing Company
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ARMSTRONG
Grates and Stokers
"TRY 'EM BEFORE YOU BUY 'EM"

Mechanical Stoker
Semi-Mechanical Stoker
Hand Stoker (Heavy Duty)
Hand Stoker

A Stoker for Every Boiler

HUBER STOKERS

Send for a Copy of "Five Minutes with the Coal Bill".

FLYNN & EMRICH COMPANY
305 *North Holliday Street*
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Automatic COAL Burner

VARIABLE SPEED SMOKELESS

PULVERZONE

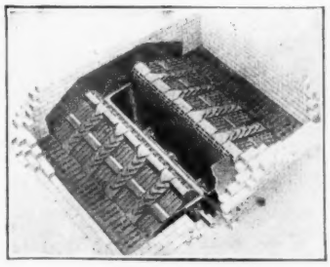
COMBINED WITH **COKAL** CUTS COAL COSTS

"The world's simplest Stoker"

CoKal Stoker Corporation, Wrigley Bldg., Chicago

The HART STOKER

has these Five Special Features:



1. The Central Retort Stoker that positively distributes the fuel over the entire grate surface.
2. Necessary agitation of the coking coal is near the crust of the fuel bed.
3. Hart Renewable Tuyeres prevent stratifying or jetting air currents.
4. Air system arranged in zones permits a definite relation of air to fuel supply.
5. Flexibility of operation that is automatically controlled.

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The Hart Stoker, Ltd., Weightman Bldg., Phila., Pa.

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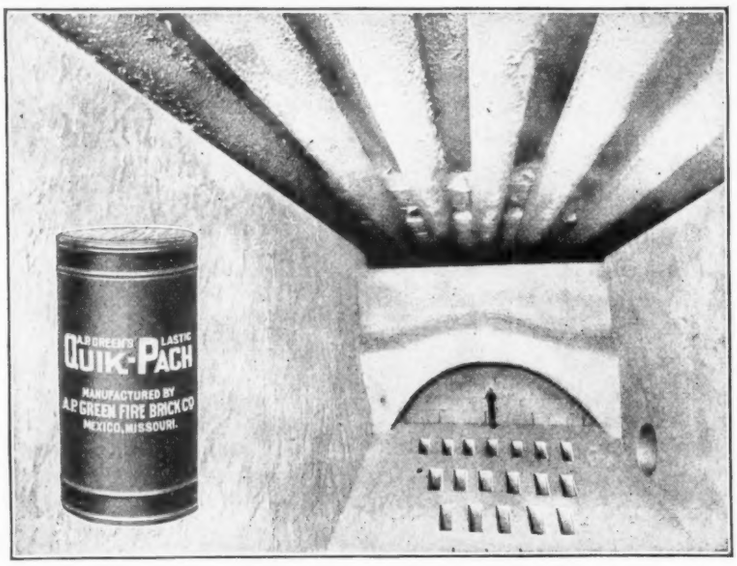
HIGH TEMPERATURE FIRE BRICK CEMENT

A.P. GREEN'S PLASTIC
QUIK-PACH
FIRE BRICK *IN PLASTIC FORM*



Furnished in 175 and 500 lb. Metal Barrels.

In Using Plastic—

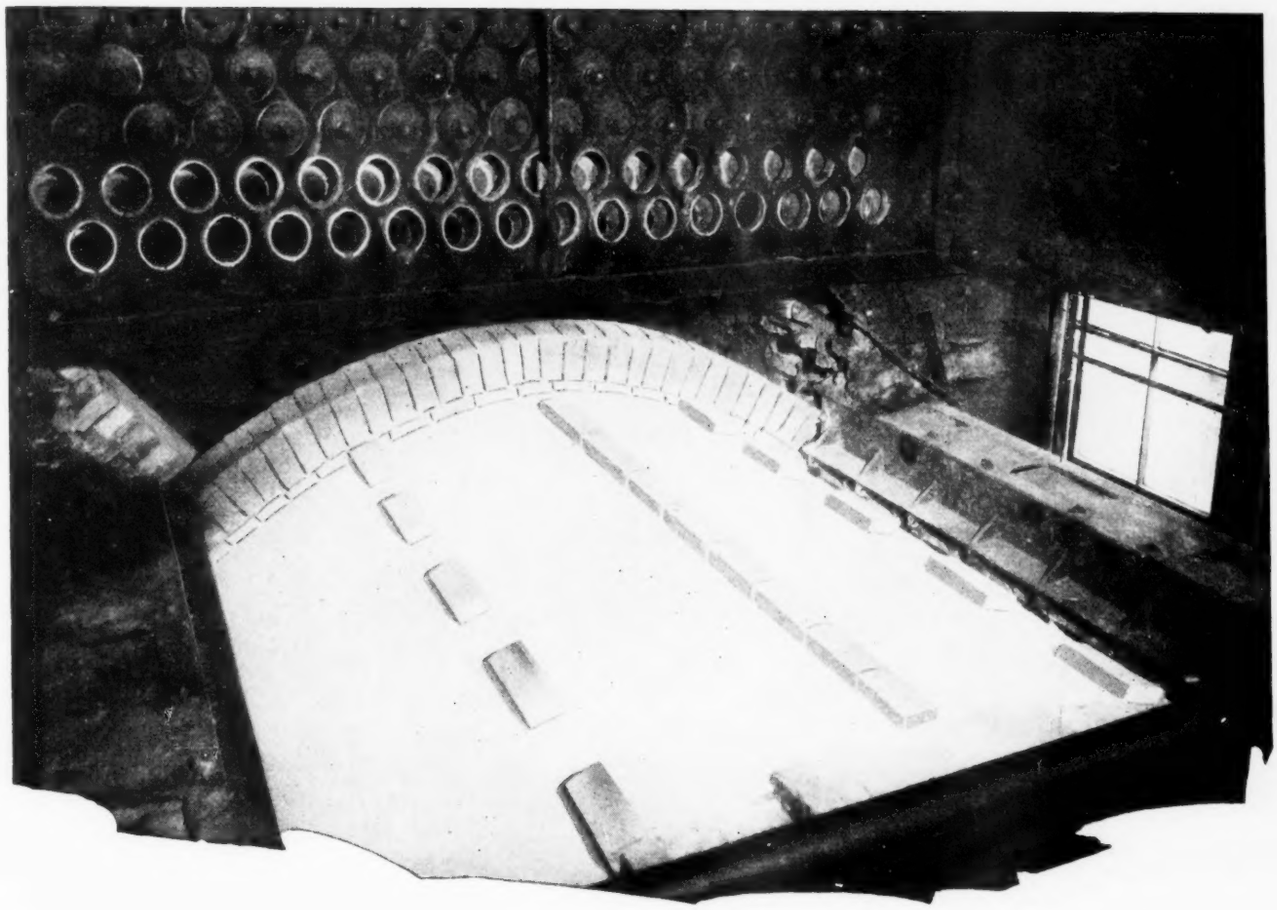
It is very important that quality be of the very best—and uniform

QUIK-PACH is fire brick in plastic form—used extensively for complete furnace linings and quick, permanent repairs. The responsibilities of plastic are as great as those of fire brick. So we make QUIK-PACH from the same high grade Missouri flint fire clays [new materials, thoroughly calcined] as are used in "Empire" and other high grade A. P. Green fire brick.

Prompt Delivery for Distributors Stocks throughout the Country

A.P. GREEN FIRE BRICK CO.
MEXICO, MISSOURI, U. S. A.

'SAIRSET is another A. P. Green Product—an air-setting "all-temperature" cement for [1] laying fire brick; [2] washing or surfacing fire brick work; [3] mixing with grog to make quick repairs.



Safeguarded against high furnace upkeep

This boiler furnace is well protected against the ravages of extreme temperature fuel bed abrasion and infiltration of cold air through the setting.

In the photograph only the top of the dutch oven arch can be seen. The top of this arch is sealed tight against air leakage by a 2 in. thickness of "White Flame" Cement. Likewise all the furnace structural steel work and the cast iron stoker front are protected against excessive heat by "White Flame" Cement.

"MONO" Boiler Baffling secured proper gas flow through the boiler passes—with maintained gas tightness.

The fire brick lining of the furnace, combustion chamber bridge wall and arch is laid up with "Blue Flame" Cement and veneered with "Red Flame" Cement. To minimize the effects of flame, erosion and temperature the brickwork in the combustion chamber is coated with "Wet Plastikdo," High Temperature Cement.

A complete job—designed by experienced combustion engineers.

Ask us to send you booklet on "Flame Brand" High Temperature Cements and "Mono" Baffles.

Flame Brand

High Temperature Cements:

"White Flame" Brand for heat insulating and air tight construction.

"Blue Flame" Brand for laying up fire brick.

"Red Flame" Brand for veneering furnace linings.

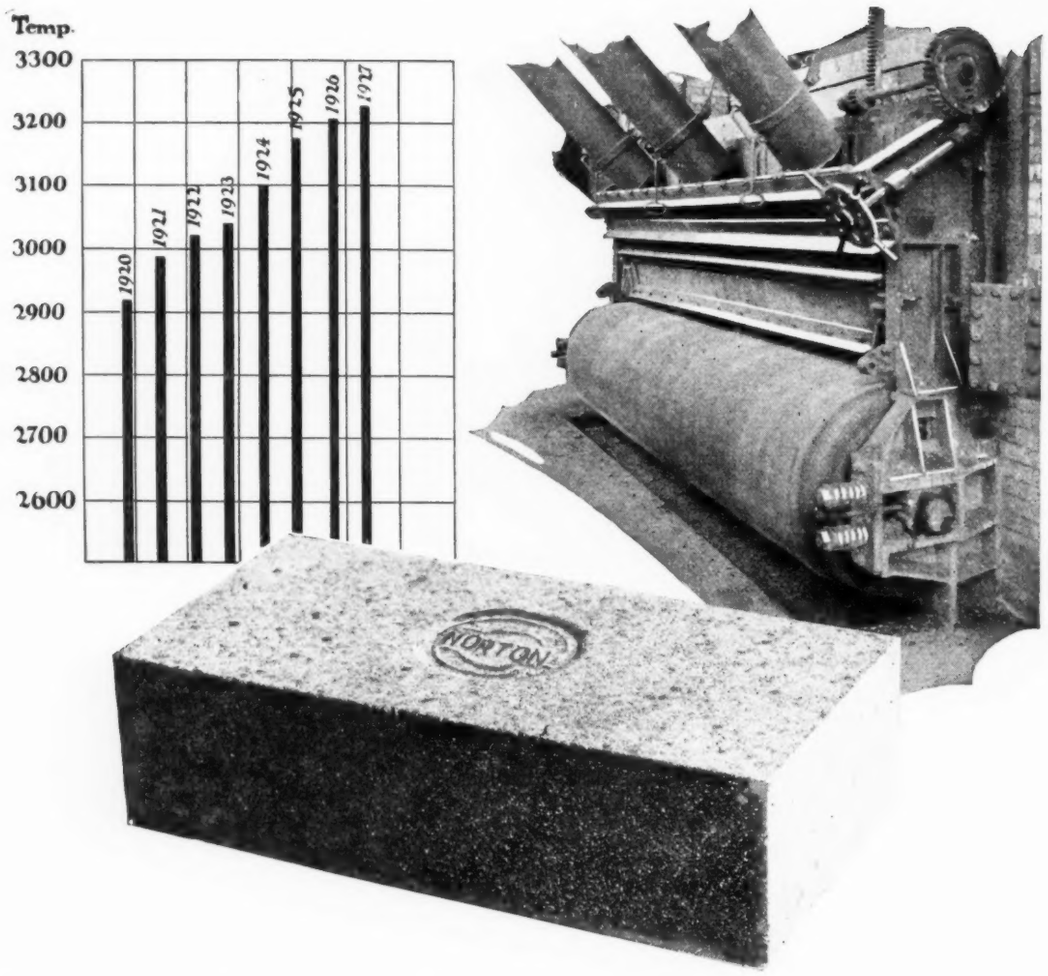
Plastikdo
Wet or Dry for patching and building monolithic linings.

Ramet
for rammed in linings.

King Refractories Co., Inc.

Main Office and Works

1709-1715 Niagara St., Buffalo, N. Y.



Rising Boiler Furnace Temperatures Demand Super-Refractory Brick

Furnace linings fused and abraded resulting in frequent take downs and costly relinings bear evidence of the inability of fire brick to withstand the extremes of temperature met in modern super-stoker-fired boilers.

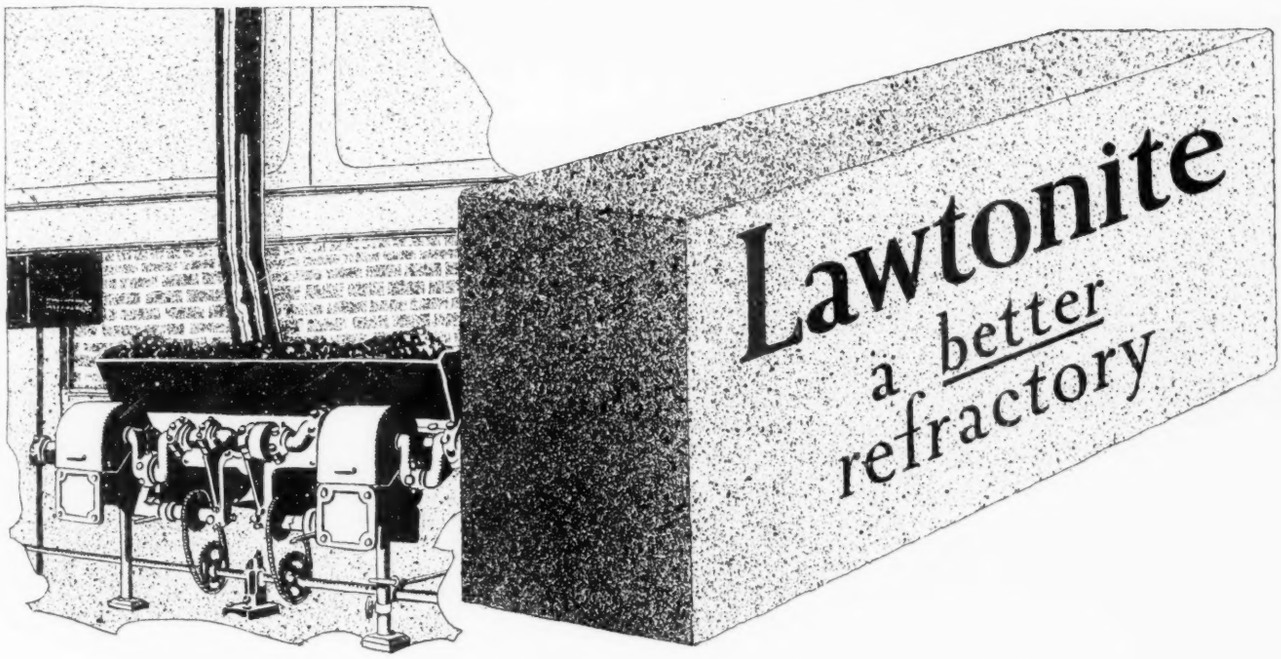
In the spots where fire clay brick fail Crystolon Brick are coming into use—the modern answer to a modern problem. They are made from silicon carbide carefully bonded to meet high temperatures and abrasive action.

Under standard test conditions Crystolon Brick show no deformation under a load of 50 pounds per square inch at 1500° C. (2732° F.).

The 9-in. series is carried in stock.

NORTON COMPANY, WORCESTER, MASS.

NORTON REFRACTORIES



Here's a little problem in mental arithmetic

Special coping brick designed for forced draft chain grate stokers, handling fine fuels, serves to prevent coal from being blown through Chain Openings in boiler front. Economies in this direction approach at least 90 per cent. Especially designed for Coxe Stoker or Type E Stoker

Write us for Catalog, entitled:

"LAWTONITE REFRACTORY FACTS"

SUPPOSE it costs you $200.00 to repair the firebrick in one of your furnaces. The job requires the labor of three men and the boiler must be out of service for two days. Do you welcome the inspector's report—"Boiler needs re-lining?" It's up to you. It isn't necessary to take boilers off the line as often as you do. Firebrick isn't always what it is pictured. Its job is a severe one and it's hard to tell the good from the bad.

Users of Lawtonite—a better refractory, invariably get from three to five times the life of ordinary firebrick. It costs more, to start, but figure it over a year's time and put the savings in the bank!

One-third to one-fifth of the labor! Less than cheap brick in a year's total cost! Boilers down for re-lining only a fraction as often.

Proof? Try it yourself—a small order. Then judge.

LAWTONITE
GRAPHITE AND CLAY PRODUCTS
TRADE MARK
REG. U.S. PAT. OFF.

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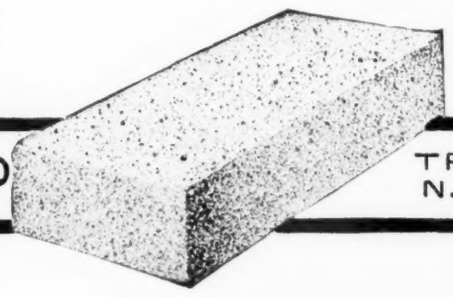

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Alphons Custodis Chimney Construction Co.
95 Nassau Street, New York
Marquette Bldg., Chicago

Perforated Radial Brick Chimneys

BUILDERS OF THE TALLEST AND LARGEST CHIMNEYS IN THE WORLD

Anaconda Copper Mining Co., Anaconda, Mont., Height 585 ft. above grade. Top diam. 60 ft. Chimneys of all sizes, for all purposes, for boilers, furnaces, chemical plants, destructors, etc. Experts in repairing chimneys. Lightning rods installed and repaired. Specifications, plans, designs and data furnished free upon request.

Send for free booklet P4 "How to Determine The Proper Size of Chimney," and "A Treatise on Calculation of Stresses in Brick Chimneys."

ATLANTA	DALLAS	RICHMOND
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WIEDERHOLDT CHIMNEYS

Reinforced Tile Concrete Construction
The Best for Severe Service
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Brick Chimneys--Boiler Settings

give lasting service under severe operating conditions. Designed and built by men with long experience.

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DURA-STIX

has achieved a dignified reputation for faithful service to industry.

Bonds and *Extends* the life of fire brick in the best known plants of America. *Booklet PH tells how.*

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CHIMNEYS—Brick and Concrete
Boiler Settings—Power Plants
New York Birmingham Washington

ADAMANT
FIRE BRICK CEMENT
Reg. U. S. Pat. Off.

The Original High Temperature Fire Brick Cement
Write for service data and information
BOTFIELD REFRACTORIES COMPANY
785 South Swanson St., Philadelphia, Pa.

Plibrico—*the superior plastic*

gives 2 to 4 times the life of ordinary firebrick. The old reliable. Made entirely of Eastern clays, by world's largest makers. A *flexo-anchor* in each drum. Over 19,000 users. Stocks, engineers, and boiler setting crews in 90 cities. Write Plibrico Jointless Firebrick Company, 1844 Kingsbury St., Chicago.

FREE
The new 36-page book, "Cutting Furnace Costs." Write for it!

STEEL MIXTURE
Furnace Linings and Arches

Boiler Door Arches, Fire Box Lining, Back Arches (for h. r. t. boilers), Flat Suspended Furnace Arches, Veneer and Air Cooled Walls, Standard Fire Brick, High Temperature Cement. *Write for Booklets.*

McLEOD & HENRY CO., 31 Monroe St., Troy, N. Y.
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BOILER SETTINGS
Write! ANYWHERE

GEO. P. REINTJES CO.
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How To Baffle Boilers

Ask for Bulletin "P" which tells and shows how to baffle water tube boilers. Make your boilers extract maximum heat. Do not permit gas leaks. Specify the only positive expansion joint. BECO Baffle explained fully. Send details for quotations.

Boiler Engineering Co.
931 Federal Trust Bldg., Newark, N. J.

Turner Baffle Walls
Produced exclusively by The Engineer Company

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The Engineer Co.
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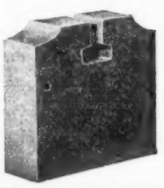
Balanced Draft
Produced exclusively by The Engineer Company



There are now more than 11,000 installations of DETRICK ARCHES and DETRICK SECTIONAL SUPPORTED WALLS in satisfactory service.

The experience gained in solving this large number of furnace problems is offered to you for the solution of your own.

M. H. Detrick Company
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WALSH FIRE BRICK
FROM COAST TO COAST
WALSH FIRE CLAY PRODUCTS CO.
ST. LOUIS
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Queen's Run Glass
THE UNEXCELLED REFRACTORY FOR BOILER FURNACE LINING
"LET US SERVE YOU"
QUEEN'S RUN REFRACTORIES CO. INC.
LOCK HAVEN, PA.

ENGINEERS
who know good fire brick construction insist on
HYTEMPITE
(Reg. U. S. Pat. Off.)

For Furnace Construction and Maintenance

Because Hytempite gives more than a surface bond. It bonds through the entire wall. The thin strong joint resists erosion. Fire Brick bonded with Hytempite give long service.

Quantity guaranteed is 400 lbs. to lay 1,000 firebrick.

HYTEMPITE is universally used for laying up firebrick in all types of furnaces, boiler settings, arches, etc. (and when mixed with crushed old firebrick or Ganisand), for monolithic construction, baffles, patches, repairs, special shapes and tile, etc. A copy of "Hytempite in the Power Plant" should be in the hands of every Power Plant Superintendent and Engineer. Ask for yours.

Quigley Furnace Specialties Co., Inc.
26 Cortlandt Street New York City
Stock and service men in every Industrial Center

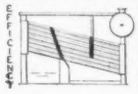
WHICH WILL IT BE?

POOR GOOD
Combustion

Let Page baffles solve this puzzle!

Good baffling means good combustions. It also means *Page* baffling. Many half skeptical prospects have been converted to enthusiastic repeat order customers by the proof of this fact.

PAGE BAFFLE WALLS



Yet Page service means something more! Not only are the immediate problems of complete combustion solved—a workmanship and quality is built into each job that makes it *lasting*.

"Quality Service at the Right Price."

The Fred'k Page Contracting Co.
45 E. 17th St., New York City

The Standard for 82 Years
LACLEDE FIRE BRICK
LACLEDE-CHRISTY, ST. LOUIS, U.S.A.
Originators of *Suprafrax*, the Super-Refractory
KR235

FIRE BRICK
The intense blasting heat of modern furnaces, demands something more than ordinary refractory protection. United States Refractories stand the abuse and give longer life. It pays to line your furnaces with them. Test them and see.
Consult us on your requirements.
UNITED STATES REFRACTORIES CORP.
Mt. Union, Penna.
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GENERAL REFRACTORIES COMPANY
117 South 16th St., Philadelphia, Pa.
Fire Clay, Silica, Chrome, Magnesite and Diaspore (High Alumina) Refractories, Grefco Chrome High Temperature Cement.
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5057 WOODWARD AVENUE
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Send for Catalog.

MORSE SYSTEM *fuel-oil*
Combustion Service Corporation
Sole Distributors
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PITTSBURGH COAL CO.
CHAMPION STEAM COAL
PITTSBURGH, PA.
CLEAN - UNIFORM - WELL PREPARED AND SIZED TO MEET YOUR REQUIREMENTS
PITTSBURGH COAL CO., PITTSBURGH, PA.

COAL—GAS—OIL BURNERS
PEABODY
112 EAST 42nd ST. NEW YORK

One Sauerman Scraper Solves *Three* Problems

—cleans out intake channel —fills in low land —handles reserve supply of coal

The Sauerman Power Scraper Reclaiming Coal

When the engineer and the manager of the Lafayette (Ind.) plant of the Northern Indiana Gas & Electric Company requisitioned the company's main office for the purchase of a $\frac{3}{4}$ cu. yd. Sauerman Power Drag Scraper for storing coal, they "killed three birds with one stone."

In the first place, they used the Sauerman Scraper to cut back the bank of the Wabash River in front of the intake house, so that sand and dirt no longer washes in to clog the intake channel.

Secondly, and at the same time that it cut back the river bank, the scraper filled in a swampy area beside the plant. By operating the scraper on a 700-ft. span, the material dug from the river bank was spread over the low ground; so two problems were solved simultaneously.

Most important, the scraper was then moved over next to the power house, and permanently reinstalled for storing coal. Here the scraper worked over an area 200 ft. square, where it could pile about 20,000 tons, if necessary, and reclaim any part of this tonnage to the plant as required.

The scraper was operated intermittently—when there was a surplus of incoming coal. Even on this part-time work, the economy of this one-man storing and reclaiming system surprised the management.

In addition, the installation cost of the Sauerman Power Scraper equipment was considerably less than the system of conveyors that had been originally proposed for the coal storage work—and the conveyors couldn't have handled the cut-and-fill job.

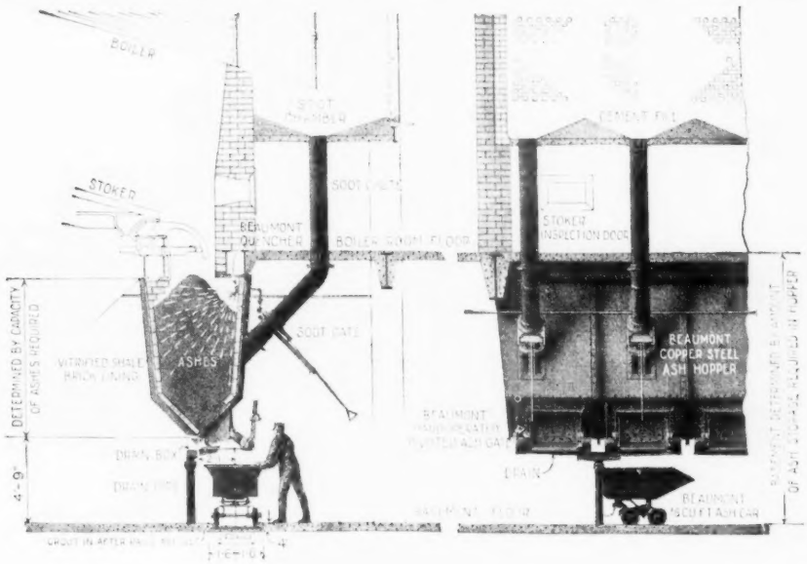
Sauerman Power Scrapers are adaptable to all kinds of excavating and material-handling tasks, both large and small. They range in size from $\frac{1}{4}$ to 10 cu. yd. capacity, with various lengths of cable spans. For complete specifications and illustrations of typical installations, write for Catalog No. 8.

SAUERMAN BROS., Inc., 462 Clinton St., CHICAGO

SAUERMAN

POWER SCRAPERS FOR COAL STORAGE

Beaumont
PIVOTED ASH GATES
for discharging to small ash cars and larries



Only a Car can carry a two foot Clinker!

Beaumont Pivoted Ash Gates have ample opening to pass such a lump.

Features!

1. Has a large opening.
2. It is easy to operate because it is counterweighted.
3. Permits clear view into hopper.
4. The gate is self contained.
5. Permits maximum ash storage with minimum depth of basement.
6. Large enough to pass the largest clinker.
7. Ample leverage to open and shut rapidly and positively.
8. Non-binding.
9. Non-leaking.
10. Made of best quality cast-iron and will not warp or rust.
11. Will not drip hot water on the workmen.
12. Easy accessibility.
13. Perfect quenching water collection.

That ash handling system for your plant—will it handle clinkers?

Not only three and four inch ones—but two-footers!

Remember they come that big and bigger. You can't hope to get rid of them like water.

There is one sure way of handling clinkers. That's with Beaumont Pivoted Ash Gates discharging to ash cars or larries. The largest clinkers will pass out of these gates and there is nothing to be clogged in the ash car.

Put your ash handling problems up to Beaumont. The experience of the Beaumont organization has made possible the easiest and safest operating conditions for the workmen. The performance of the equipment has made economies that are even more pleasing to the management.

Send for one of our engineers to assist in solving your conditions.

Beaumont Mfg. Co.
322 Arch St., Phila. Pa.

Gentlemen-
Please send us full information regarding Beaumont Copper Steel Ash Hoppers and Underdry Pivoted Ash Gates
Company _____
Individual _____
Address _____

BEAUMONT MFG. CO.

322 Arch Street, Philadelphia

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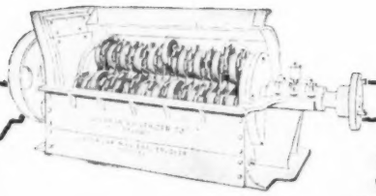
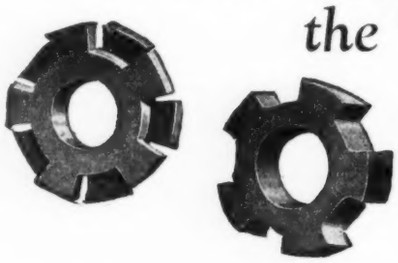


Size Your Stoker Coal the "Rolling Ring" Way



The manganese steel patented scraper and shredder rings are the secret of our perfection.

The proper sizing of stoker coal, for maximum boiler efficiency, is accomplished by the rolling ring principle used in all American Ring Coal Crushers. The combination of the rolling rings, shredder rings or scraper rings and grate bars makes it possible to produce the required size of product.

American Ring Crushers will pass tramp iron with ease, due to the flexibility of the Rolling Ring System. The flexibility of the rotor also accounts for the low power consumption per ton of crushed material.

ORIGINATORS OF THE ROLLING RING CRUSHER PRINCIPLE

AMERICAN PULVERIZER CO

18 th & AUSTIN STREETS ST·LOUIS·MISSOURI

BLAW BUCKETS KNOX

A Complete Line of CLAMSHELL BUCKETS For every Industrial Purpose

The Husky DREADNAUGHT A General Purpose Bucket for All Around Use — The First Choice in many industries.

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It's Cleaner!

BITUMINOUS VICTOR COAL

Mines developed and mechanically equipped for an output of FOUR MILLION TONS annually.

Miners and Shippers of
VICTOR
SPRINGFIELD
PORTAGE
*"PNEUMO-GRAVITY"
Semi-Bituminous Coals

*The "PNEUMO-GRAVITY" Process installed at several of our mines is a DRY method for the MECHANICAL removal of REFUSE and other IMPURITIES from the COAL, thus assuring to the consumer, CLEAN' UNIFORMLY PREPARED COAL.

Anthracite

PEALE, PEACOCK & KERR
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BROWNHOIST

Locomotive Cranes
Chain Conveyors
Belt Conveyors
Clamshell Buckets
Coal Crushers
Coal Bins

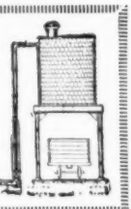
The Brown Hoisting Machinery Company
Cleveland, Ohio

Hydrojet Ash Sluicing Systems
Water Collecting Ash Gates
Cast Iron Ash Hoppers, Tanks & Coal Bunkers

ALLEN-SHERMAN-HOFF COMPANY
261 South 15th Street, Philadelphia

UNITED STEAM JET CONVEYORS

The Conveyor with *Exterior Wear Sections*
For Handling Ashes, Coke Breeze, Etc.
STORAGE BINS FOR ASH AND COAL



United Conveyor Corp.
Old Colony Bldg., Chicago, Ill
New York City,
Room 403, 1269 Broadway

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PUMPS

Manistee Iron Works Co., Manistee, Michigan

WORTHINGTON

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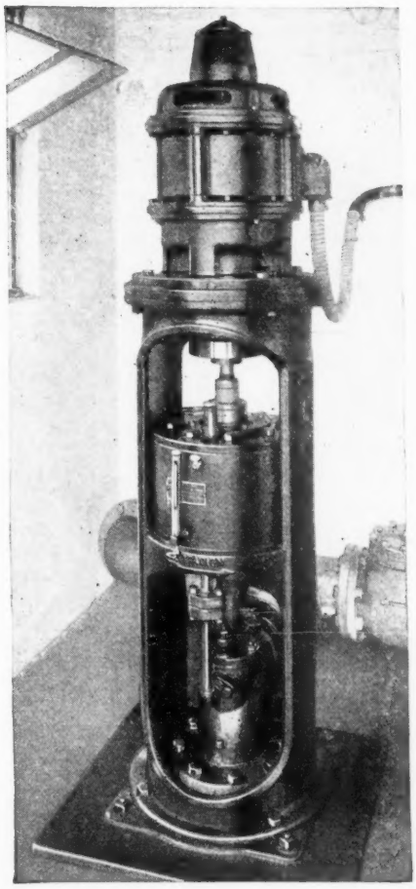
Pumps

Compressors

Condensers *and* Auxiliaries

Oil *and* Gas Engines

Meters *Boiler-feed, Water, Oil*



One of the 13 AXIFLO Pumps at the Textile Dyeing Company of America, Hawthorne, N. J., used to supply suitable water for process work.

Also manufacturers of AXIFLO Sump Pumps (automatically controlled) and single-, two- and three-plunger reciprocating deep-well pumps.

AXIFLO and CONIFLO Deep-well Pumps

A means of cooler, better and cheaper water supply

WATER from deep-wells is cool and clean—better suited for many purposes than city or river water. So low is the cost of pumping with Worthington AXIFLO and CONIFLO Deep-well Pumps that frequently it is cheaper to pump one's own water than to purchase it. Repeat orders with praise for the pumps already in service, testify to their reliability, economy and long life. One industrial plant alone has sent in six repeat orders.

A few users and uses to which these pumps have been put are listed below:

Textile Dyeing Company of America, Hawthorne, N. J.
13 AXIFLO Pumps. City and nearby river water not suited for process work.

Farley and Loetscher Company, Dubuque, Iowa
CONIFLO Pump used to supply cool circulating water for surface condensers.

Ware County Power and Light Company, Waycross, Ga.
CONIFLO Pump used to supply cool circulating-water for surface condenser.

Fisk Rubber Company, Chicopee Falls, Mass.
Three CONIFLO Pumps. Used to cool tire moulds. Water temperature about 50 deg. F. even in mid-summer.

Consolidated Rock Products Company, Brooksville, Fla.
CONIFLO Pump supplies 3,000 gallons of water per minute to stone washers.

LaFayette Box Board and Paper Company, LaFayette, Ind.
Three AXIFLO Pumps used for general water supply.

Dixie Spinning Mills, Chattanooga, Tenn.
AXIFLO Pump supplies mill and community of 1,200 people.

Waterworks at Ocean City, N. J., Endicott, N. Y., Oil City, Pa., etc.

Ice, Refrigeration and Cold Storage Plants
Lower temperature of water as compared with city or river water a great advantage—reduces power costs.

Capitol Theater, St. Paul, and State Theatre, Minneapolis.
AXIFLO Pumps for air washing, cooling and ventilating.

Further information is given in Bulletin 31-D-315 which will be gladly sent on request

6335-2

WORTHINGTON PUMP AND MACHINERY CORPORATION, 115 BROADWAY, NEW YORK CITY. BRANCH OFFICES IN 24 CITIES

The Regulating element. Exceedingly simple. No moving parts. Just two tiny orifices, plus steam and water.

The Connecting Pipe Any shape. Any length. Any size.

The Control Valve This is a REAL control valve. Positive. Tight. Any size pipe. A gauge accompanies every regulator.

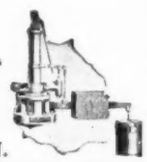
The
CAMPBELL
(Protected by Patent Application)
Boiler Feed Water
REGULATOR

Maximum satisfaction in feed water regulation is assured in the Campbell Regulator by two fundamental features of construction. It is based on an entirely new engineering principle. It operates independently of floats, thermostats, governors and other moving parts—direct from the water level. The Campbell is easily installed on any boiler by any man who can cut and fit pipe.

Regulating Valves for Every Service

On Which Do You Want Information?

- ☐ Feed Water Regulators
- ☐ Reducing Valves
- ☐ Damper Regulators
- ☐ Temperature Regulators
- ☐ Pump Governors
- ☐ Float Valves
- ☐ Swing Joint Fittings
- ☐ Bronze Unions
- ☐ Thermostats
- ☐ Balanced Valves



Atlas Valve Co., 289 South St., Newark, N. J.

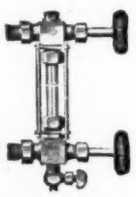
Continuous operation assured

PENBERTHY PRODUCTS

Automatic Injectors

The engineer runs no risk with a Penberthy, for it must pass a severe test under actual service conditions before leaving the factory.

There are over 1,250,000 in service in all parts of the world.



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PENBERTHY INJECTOR COMPANY
Established 1886

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236 Holden Ave., Detroit, Mich.

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THE ALDRICH PUMP COMPANY
Department "A"
ALLENTOWN, PENNA.

REPRESENTATIVES WANTED

SINGLE SUCTION "EARLE" TYPE SINGLE STAGE
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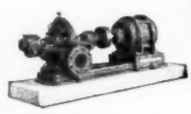

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Single Stage Double Suction Centrifugal Pumps
Bulletin No. 206
PENNSYLVANIA PUMP AND COMPRESSOR COMPANY
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"Buffalo" Pumps

Superior Design
Efficient—Dependable

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Mitchell Electric Vibrating Screens, Cut-off Valves or Gates, Industrial Railways, Automatic Railways, Cable Railways, Cars, Tracks, Switches, Motor Cars, Scales, Conveyors, Skip Hoists, Weighing and Measuring Devices, Coal Crackers, "Stevedore" Transmission Rope and Hoisting Rope, Hunt Rope Couplings, "Stevedore" Drilling Cable, and the "Floto-Grav" (Coke Reclamation System).

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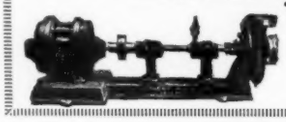
For pumps that Last · the "buy" word since 1859 has been

TABER PUMPS



Send your pump problems on a Taber Data Sheet. Write for Bulletins.
Taber Pump Co., Buffalo, N.Y.

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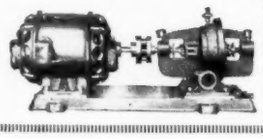

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POWER PLANT EQUIPMENT CO.-KANSAS CITY, MO.

Air Washers, Cooling Ponds, Air Filters
Self-Cleaning Strainers
Nozzles of all kinds

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CONDENSER AND ENGINEERING CO.

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CONDENSING AND HEAT BALANCING EQUIPMENT

Condensers—all types, Cooling Towers—natural and mechanical draft, Steam Jet Air Pumps, Heaters, Heat Exchangers, Expansion Joints, Centrifugal Pumps, Boiler Feed Pumps, Evaporators, Turbines, "Crescent Brand" Brass and Copper Tubes and Pipe.

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STEAM SAVING EQUIPMENT

STEAM TRAPS STEAM AND OIL SEPARATORS

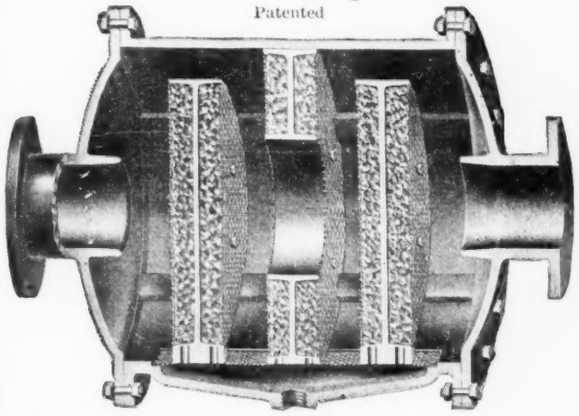
Takes oil and moisture out of exhaust steam

The

EXHAUSTEAM

Purifier and Separator

Patented



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Four distinct separating effects insure the maximum efficiency.

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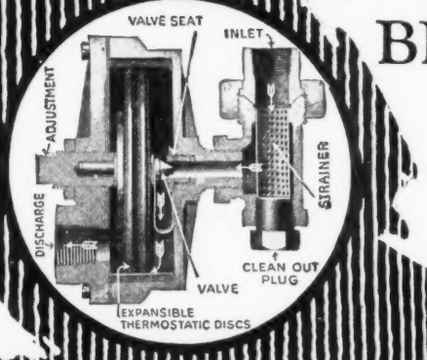

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Write for Bulletin which describes this remarkable little trap. Capacity of ½-in. size is as great as many ¾-in. and 1-in. traps. Will outlast any other trap made. Fits in the palm of the hand. Needs no bracket or support. Used for all pressures up to 150 lbs.

Write now for prices and further information.

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36 years of specialization in temperature control

2771 Greenview Avenue, Chicago. Also New York, Boston, Toronto, and 31 Other Offices. See Your Telephone Directory. (3507)

The POWERS HIGH PRESSURE STEAM TRAP

STERLING TRAPS

Return Traps ***Lifting Traps*** ***Vacuum Traps***
Separating Traps

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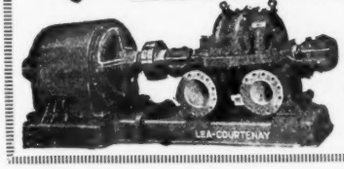

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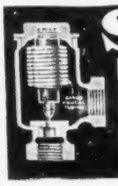
LECOURTENAY CO.
9 MAINE STREET
NEWARK, NEW JERSEY



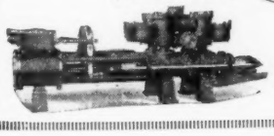
SARCO STEAM TRAP

Is self-adjusting at pressures from 0 to 100 lbs. Screws right into pipe line. Only one moving part. Costs about one-third the price of bucket or float traps. *Sold on 30 days' free trial. Booklet A-269 on request.*

SARCO CO., Inc., 183 Madison Ave., New York City

PLATT IRON WORKS - DAYTON, OHIO.

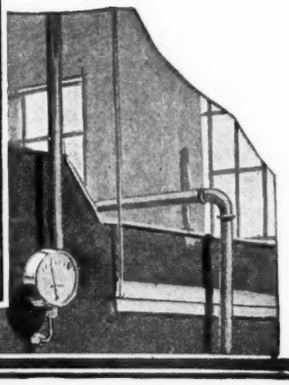
Smith-Vaile PLATT Pumps



Steam and Power Pumping Machinery

OPEN STEEL IRVING FLOORING

TRADE MARK SUBWAY REGISTERED



No hot, stifling, fume-laden atmosphere in the plant equipped with **"Subway"** Flooring—on the contrary, free ventilation and the comfort which comes with a circulating current of air.

And men like the firm, smooth, secure surface of **"Subway"**—the sure safety of its non-slipping, dirt-free surface.

Whether the job be that of standing, or walking or working, or wheeling loads, it is easier and less fatiguing when done on a floor of **"Subway"**.

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LONG ISLAND CITY, N.Y. U.S.A.

Established in 1902

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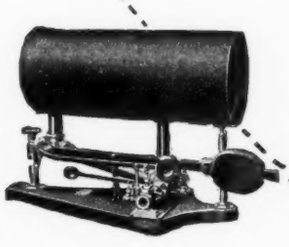
Whether the stakes are large or small

Waste *plays a winning hand*

When you put up with inefficient steam drainage, you play right into Waste's hand. How much is this little game costing you each year?

Figure it out . . . and remember that the Morehead System conquers waste by draining condensation as rapidly as it forms and returns it to the boilers *hot*. By doing this, it increases the efficiency of steam-heated equipment and cuts fuel bills by a very considerable figure. May we tell you how this is done? Write now . . . or mail coupon attached.

MOREHEAD MANUFACTURING COMPANY
DEPARTMENT P DETROIT, MICHIGAN
(204)



Morehead
Back to Boiler
SYSTEM

Morehead
Mfg. Co.
Dept. P
Detroit, Michigan
You may send me complete information regarding the Morehead Back-to-Boiler System.

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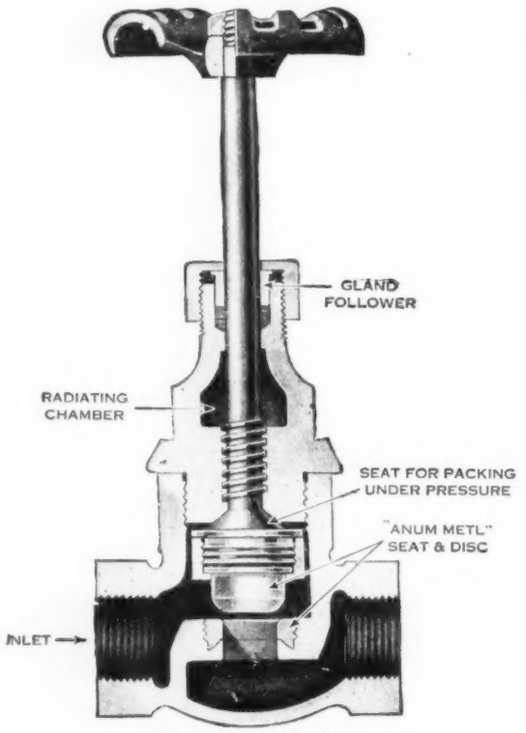
POSSESSION

Is Nine Points of the Law!



Sectional View

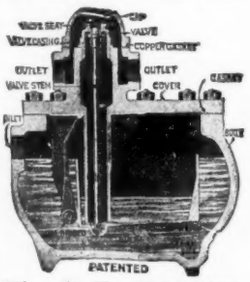
Here are nine points that Strong Evrtyte Valves possess.

1. Maintenance cost virtually eliminated.
2. All waste due to leaky valves stopped.
3. Fitted with "Anum-Metl" disc and seat —practically indestructible.
4. Disc and seat removable.
5. Metal for regrinding equal to life of body and yoke.
6. Yoke provided with radiating chamber.
7. Stuffing box may be packed under pressure.
8. Regular valves built for steam pressure up to 300 lbs. For hydraulic or cold pressure up to 500 lbs. Built, also, for hydraulic service up to 3000 pounds, ammonia service, special conditions.
9. Bronze bodies, yokes and stems. Parts machined and polished.

Send for complete information. Address—

The Strong Carlisle & Hammond Co.
1392 West 3rd St., Cleveland, Ohio

The GENUINE **Squires** STEAM TRAP

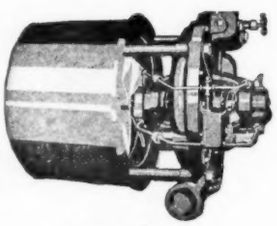


will give you the utmost in service on steam, air or gasoline.

May we send Catalog A-9 giving complete information?

The C. E. SQUIRES Co., Cleveland, O.

For Every Boiler Stokered or Hand-Fired



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The Original - The Standard since 1905

No Ducts - Low Cost
More Capacity - Better Efficiency with any fuel

L. J. Wing Mfg. Co.
9th Ave. & 13th St., New York

ELLIS STEAM TRAPS ~ TILTING AND BUCKET TYPES ~
There is nothing to equal their simple and reliable operation
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GENUINE NASON STEAM TRAPS KEEP UPKEEP DOWN
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For Ice Plants or Power Plants. Any Size. 20 gallons per minute, or 20,000 gallons per minute, in a single unit. Bulletin No. 175.

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In the Hercules Float You Get Durability

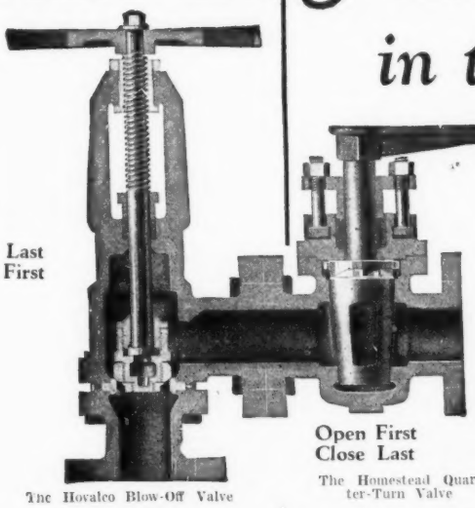
The popularity of Hercules Floats is the kind that lasts. Why? Because we have always followed our slogan, "Quality First." Made in all sizes from 2½ in. to 24 in. Write for catalogue.

HERCULES FLOAT WORKS
200 Franklin St., Springfield, Mass.

VALVES *of* LASTING SERVICE

in this economical Shop Power Plant

Open Last
Close First



The Hovalco Blow-Off Valve

Open First
Close Last

The Homestead Quarter-Turn Valve

At right, New Sullivan Machinery Co. plant, erected for the manufacture of compressed air tools and machinery that make possible our subways, tunnels, skyscrapers and many modern industries.

*See article entitled "Shop Power Plant Shows Economical Operation," in March 15, 1926, issue of Power Plant Engineering.

Homestead Protected Seat gives from two to three times the service of ordinary valves on steam, air and hydraulic services.

Three-Way Quarter-Turn Valve

Straight-Way

Homestead 4-Way Quarter Turn Valve. Also in 3-Way and Straight-Way, both regular and lubricated. Metals and types for all services, screwed or flanged.

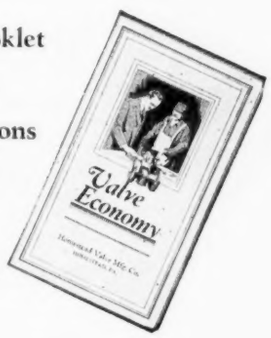
HOVALCO-HOMESTEAD Blow-Off Valves were selected for all the boilers in the new Sullivan Machinery Co. plant at Michigan City, Ind., because they are economical and reliable.*

In the Combination Blow-Off, next to the boiler, stands one of the Straight-Way Homestead Quarter-Turn Valves, developed for leak-tight, free-acting, enduring service.

The Hovalco, Homestead's contribution to safety, economy and durability on blow-off, is in front of the Quarter-Turn Valve. Hovalco regulates the blow-off. Built especially for this service with monel metal seats and discs that are regrindable, reversible and renewable. This is why a similar installation in the Singer Building, New York City, has given 14 years' continuous blow-off service.

For more economical plant operation know the many advantages of the Homestead line of "Valves of Lasting Service" backed by 34 years' experience. Consult us freely. Write for this

24-page booklet containing 30 illustrations and handy reference information



Homestead Valve Manufacturing Company, Homestead, Pa.

HOMESTEAD

PRODUCTS: Quarter Turn Valves—Straight-Way Three-Way Four-Way Types—Full Round-Way Valves—Cast Steel Refinery Valves—Lubricated Valves—Hovalco Blow-Off Valves—Protected Seat Globe Valves B & O Pat.—Protected-Seat Hydraulic Operating Valves

There's A Mason To Fit

Whatever the pressure control problem there's a Mason Regulator that will give lastingly accurate service.

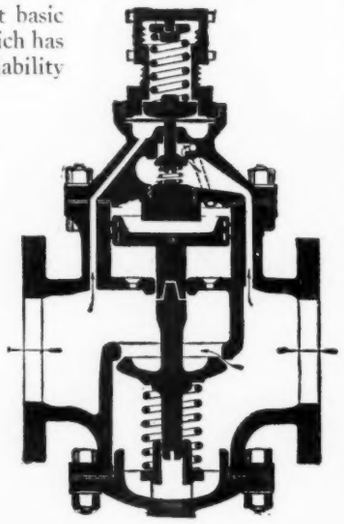
Select the type you need from our No. 62 Catalog. Or we'll build a special Mason to fit your requirements. You can't stick us on a pressure regulation job.

Keep a copy of the Mason Catalog handy for reference.

Mason Regulators
MASON REGULATOR CO.
Boston, Mass.
920

Accuracy in regulation

is obtained by a correct basic principle in design, which has proved its complete reliability for over 20 years in



LESLIE Pressure Regulators

High sensitiveness is secured by automatically protecting the controlling or auxiliary valve against foreign matter and keeping it perfectly free through the circulation permitted by an adequate and perfectly drained expansion chamber.

All parts are made and fitted with special care to insure long life and accuracy in regulation.

All sizes of Leslie Pressure Regulators carried in stock.

Write for catalog.

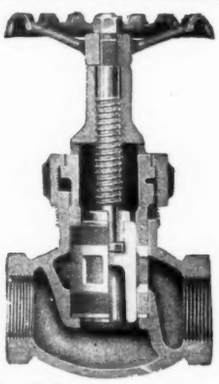
Leslie Co., Lyndhurst, N. J.

Agents in principal cities

If you have pipe lines where ordinary valves will not stand up

try PISTON VALVES

(Klinger Patents)



They are designed for severe service and have these advantages: Easy operation, no leaky seats, no wire-drawing, long life, close regulation, positive shutoff.

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SCHUTTE & KOERTING CO., 1150 Thompson St., PHILADELPHIA, PA.

DEXTER Valve Reseating Machines

for Globe Valves—for Gate Valves—for Pump Valves
See the full page ad in the issue of June 21.

Write for Catalog No. 23

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THE LUNKENHEIMER CO.
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CINCINNATI, OHIO, U.S.A.
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The LIBERTY VALVE OPERATOR
insures Safety in remote valve control.
Bulletin P-286
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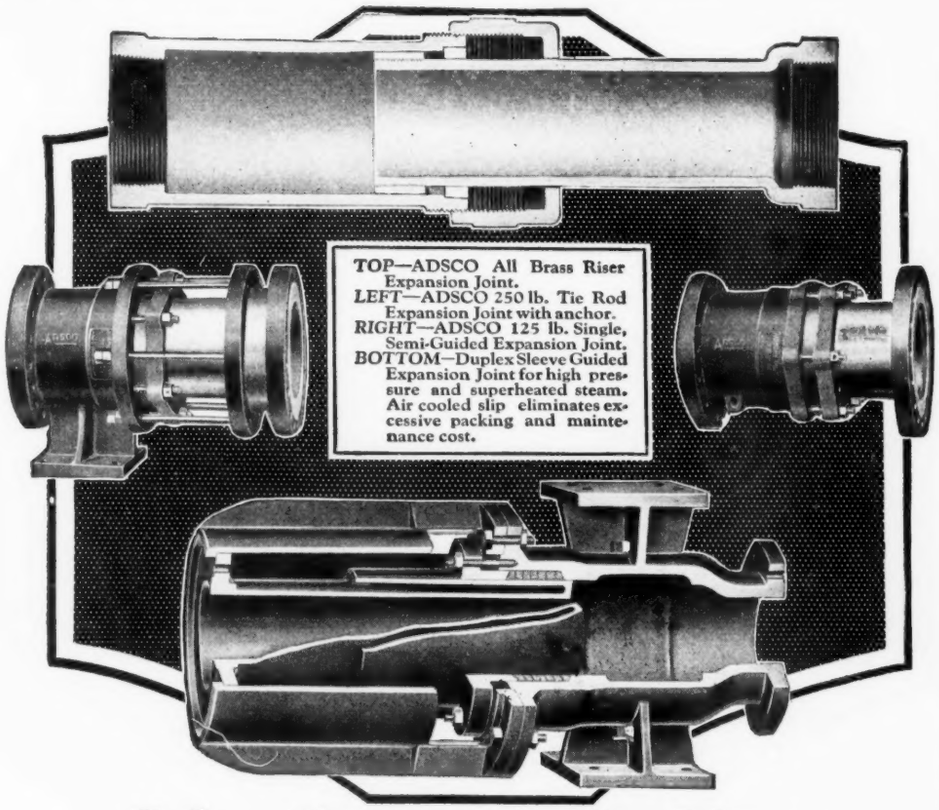
Send for free copy of **Watts Steam Flow Chart and Capacities of Watts Reducing Valves.**

WATTS REGULATOR CO.
252 Lowell St., Lawrence, Mass.

See our Ad. May 31, 1927



TOP—ADSCO All Brass Riser Expansion Joint.
LEFT—ADSCO 250 lb. Tie Rod Expansion Joint with anchor.
RIGHT—ADSCO 125 lb. Single, Semi-Guided Expansion Joint.
BOTTOM—Duplex Sleeve Guided Expansion Joint for high pressure and superheated steam. Air cooled slip eliminates excessive packing and maintenance cost.

Solve Expansion Problems

ELIMINATE expansion troubles from pipe lines with ADSCO Expansion Joints.

Built for low pressure, high pressure and superheat service—for lines conveying steam, water, oil, air, gases and liquids. Users frequently report from 10 to 20 years of continuous service without leaking or repacking.

Performance plus convenience of installation are the reasons for the increasing use of ADSCO Expansion Joints in power plants and piping work.

A scientifically proportioned stuffing box combined with correct design for anchorage and provision for careful guiding of slip is the reason why every ADSCO Expansion Joint renders long, uninterrupted service without leaking or repacking.

FREE! Valuable Reference Book

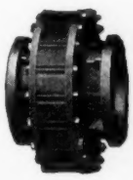
"The Blue Book on Expansion." Contains condensed tables of expansion in pipe lines and complete dimensions. Will save you much time in the selection of the correct type of expansion device for any service requirement.

AMERICAN DISTRICT STEAM COMPANY
GENERAL OFFICES AND WORKS
NORTH TONAWANDA, N.Y.

Offices and Agents in Principal Cities

ADSCO
EXPANSION DEVICES

A few of the many other ADSCO Expansion Joints



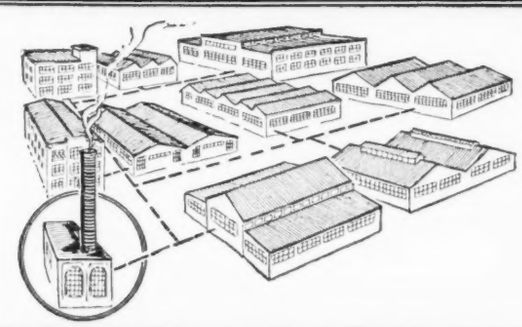
ADSCO Expansion Variator will outlast the line itself and render uninterrupted service. Packingless design. For pressure ranges up to 125 lbs.

ADSCO 250 lb. Double Externally Guided Expansion Joint with anchor and service. Allows for expansion on either side of its service connection or anchor point.

ADSCO 250 lb. Single Externally Guided Expansion Joint. With anchor, no service.

ADSCO Standard Iron Body Single Expansion Joint. Its low cost makes it an economical expansion joint to use for either hot water or steam heating work.

CUT COSTS BY HEATING ALL BUILDINGS FROM ONE CENTRAL SOURCE



SAVE fuel, labor, valuable space and the cost of boilers when new buildings are erected, by heating all of your buildings from one boiler plant through well insulated underground mains.

Reduce your own costs of heat and power by selling steam to neighboring plants and buildings.

You can install district heating in your plant, step by step, as new buildings are erected or old boilers wear out.

~AND SELLING STEAM TO NEIGHBORING FACTORIES AND BUILDINGS

A "TOLEDO" CUT THIS 4" THREAD EASILY

If you have never used a "TOLEDO" tool you do not realize how easy it is to do such a job as this one. Light—compact—it is put on the pipe anywhere and with a few easy strokes of the ratchet handle the thread is cut. No lost time, no effort, and a perfect tapered standard thread is always secured.

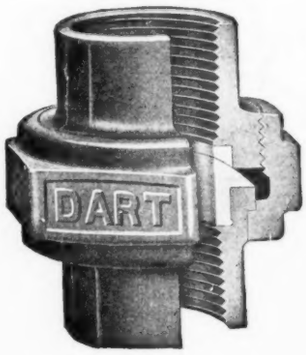
The "TOLEDO" catalog showing the complete line up to 12 in. will be sent on request.

When you Buy, Specify

"TOLEDO"

THE TOLEDO PIPE THREADING MACHINE CO. Toledo, Ohio

New York Office: 72 Lafayette St.



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We'll be glad to send you a trial Dart union—Free.

We'll send a booklet — too.

Just tell us the size you want.

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Sales Agents: The Fairbanks Company, New York and at all branches

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"WONDER" COLD PIPE, TUBING AND BAR BENDERS
Standard of the World
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14 Sizes of Machines
What it costs to bend pipe our way. Per Bend:
1-in. pipe, 5 cents 4-in. pipe, 25 cents
2-in. pipe, 10 cents 6-in. pipe, 60 cents
8-in. pipe, $1.00.

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120 Pearl St., Boston, Mass.
One Year to Pay

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R.H. BAKER COMPANY INCORPORATED

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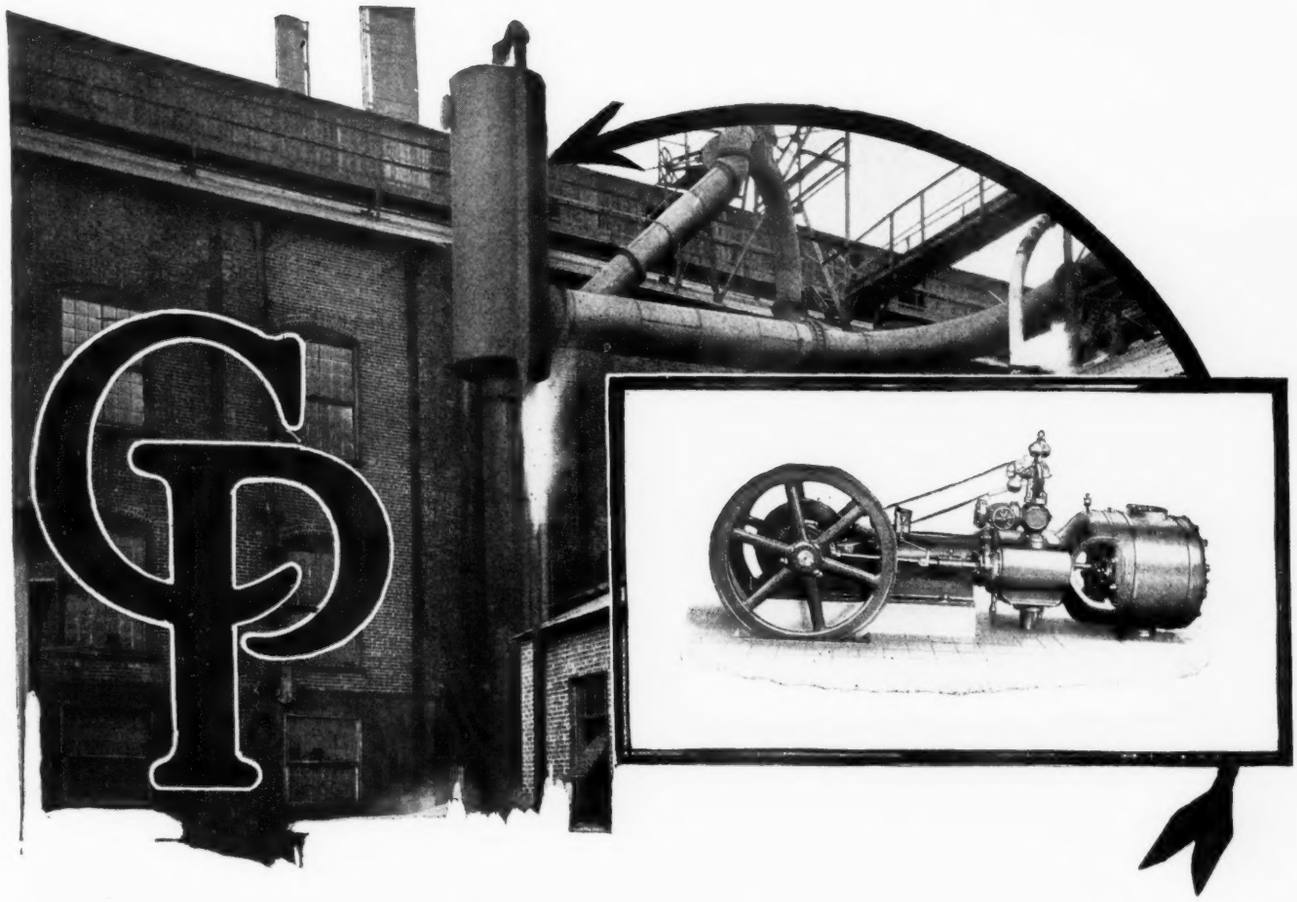

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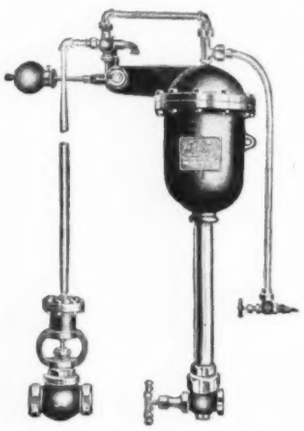

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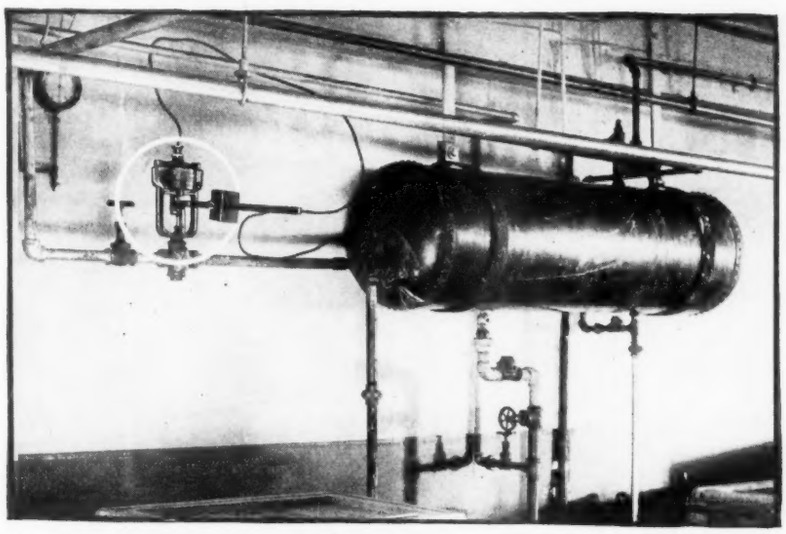

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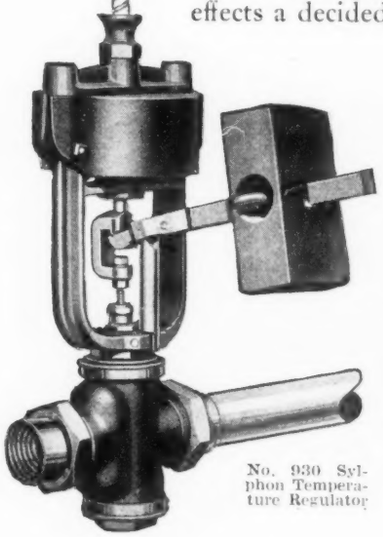

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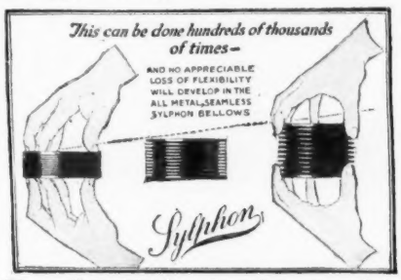
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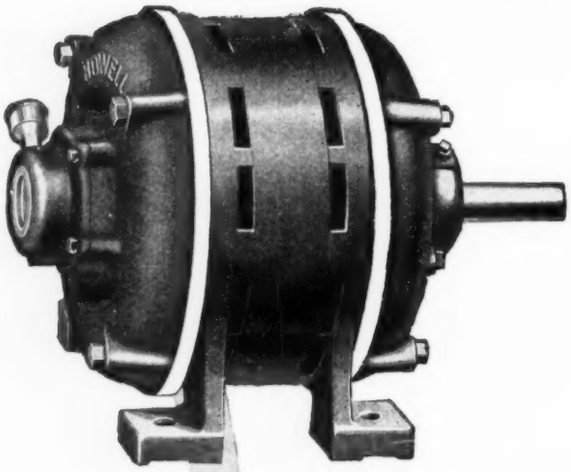

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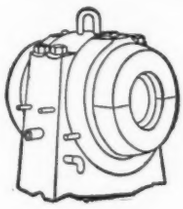
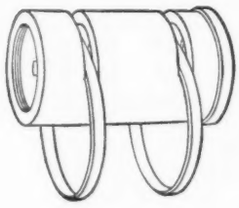

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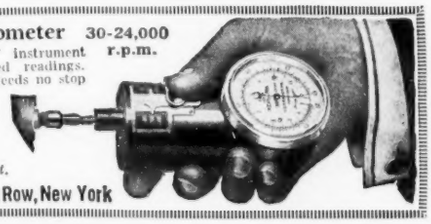

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(Continued on the following page)

(Continued from preceding page)

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TREASURY DEPARTMENT, Office of the Supervising Architect, Washington, D. C., June 14, 1927. SEALED PROPOSALS will be opened in this office at 3 p.m., July 14 1927, for furnishing all labor and materials and performing all work for the installation of a parcel post lift in the U. S. Post Office at Montclair, N. J. Drawings and specifications may be obtained from the Custodian U. S. Post Office, at Montclair, N. J., or from this office in the discretion of the Supervising Architect Jas. A. Wetmore, Acting Supervising Architect.

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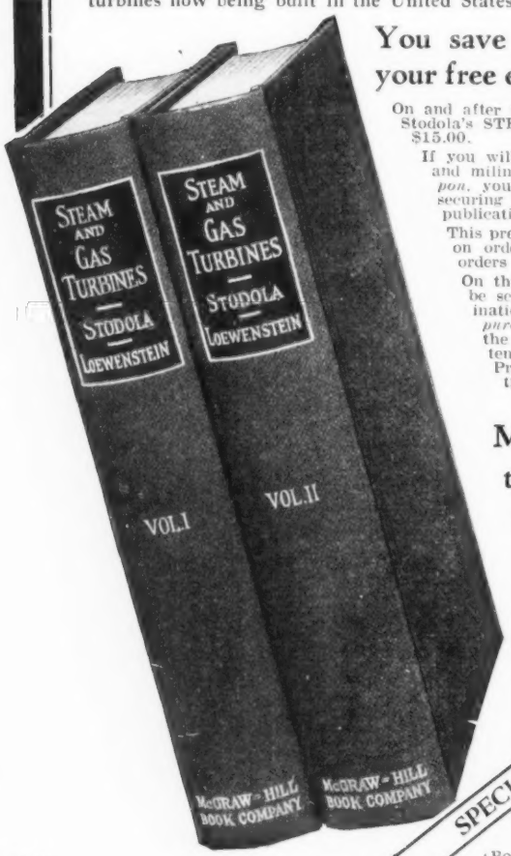

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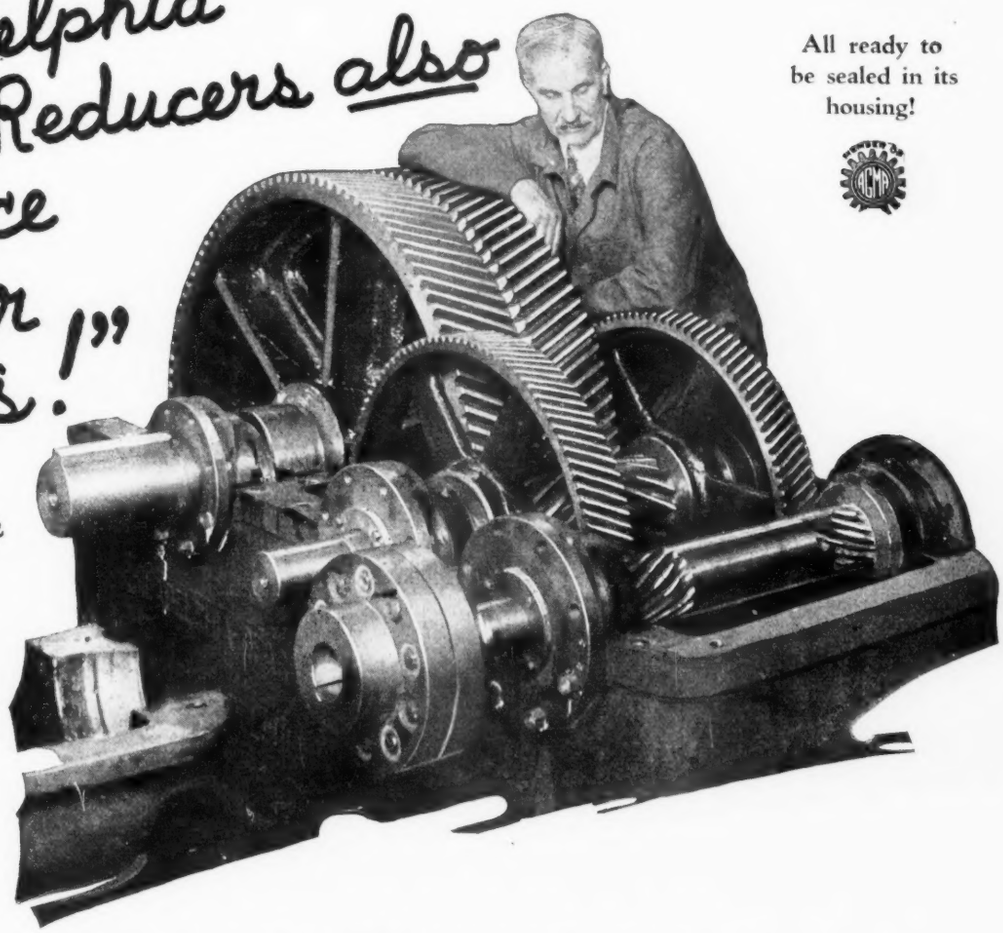

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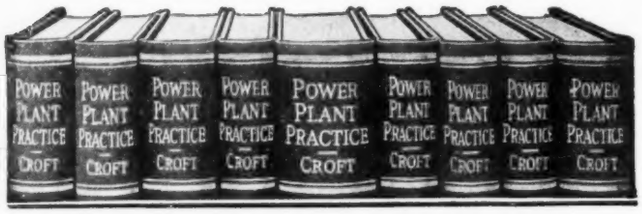

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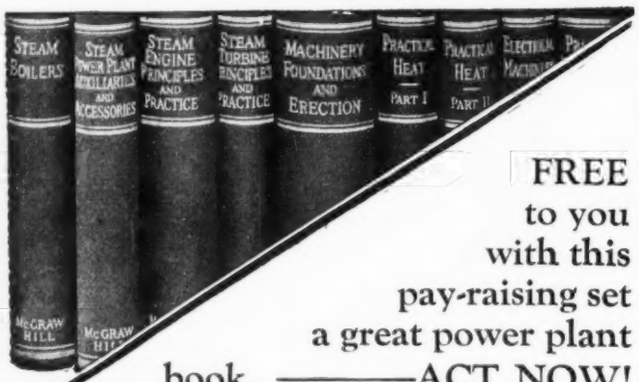

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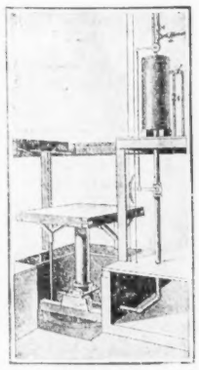

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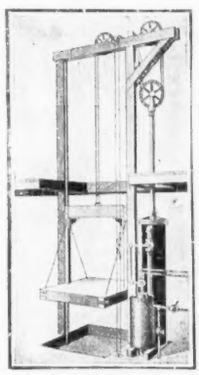

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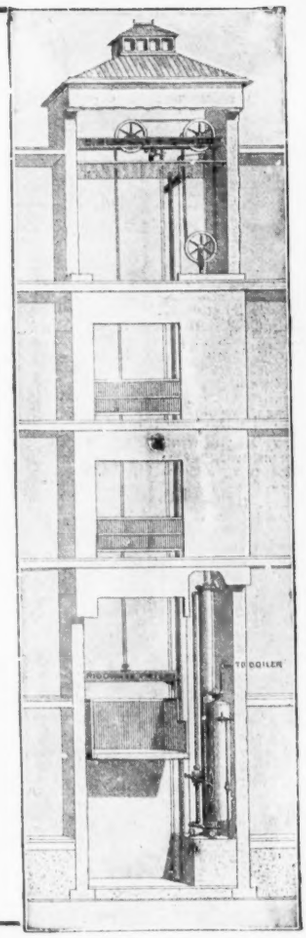

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Equipment, Apparatus and Supplies Used in the Power Plant Field with Names and Addresses of Manufacturers and Distributors Whose Advertisements Appear in This Issue

See Last Page for Alphabetical Index

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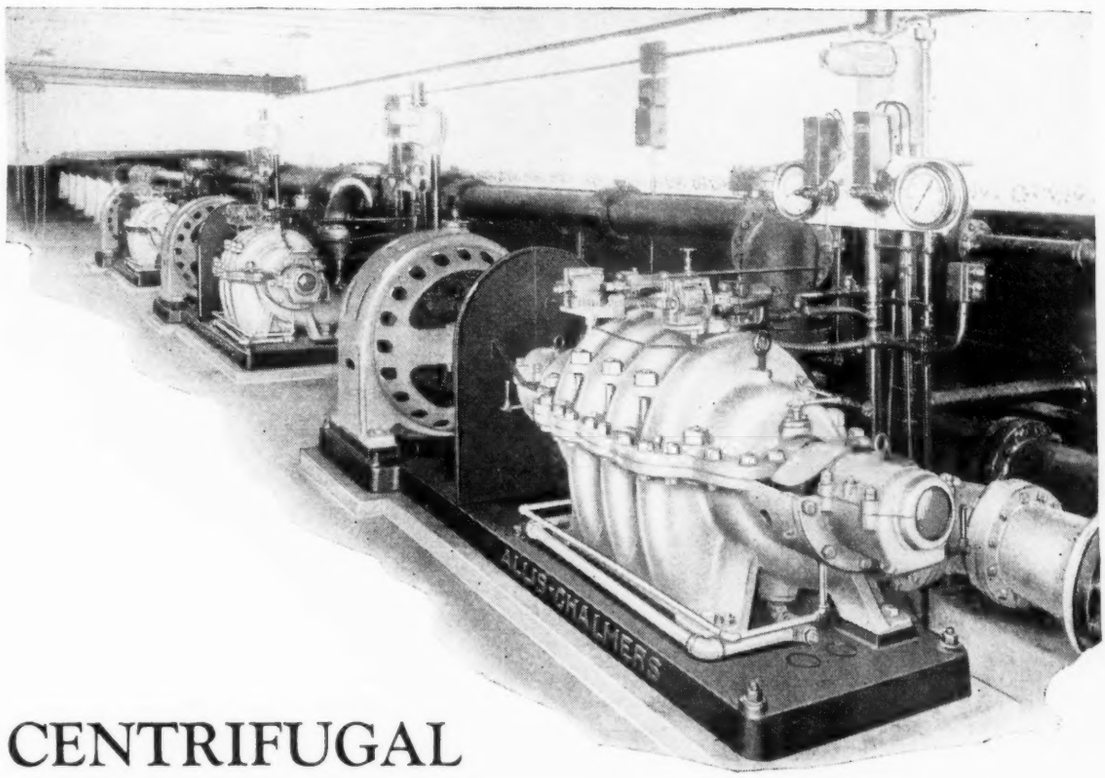
Arches, Flat, Suspended
Bigelow Arch Co., Detroit
Detrick Co., M. H., Chicago
Illinois Stoker Co., Alton, Ill.
McLeod & Henry Co., Troy, N. Y.
Walsh Fire Clay Products Co., St. Louis
Ash Gates and Hoppers for Pulverized Fuel
Allen, Sherman, Hoff Co., Phila.
Jeffrey Mfg. Co., Columbus
Ash Handling Equipment
Allen, Sherman, Hoff Co., Phila.
Combustion Engineering Corp., N.Y.
Beaumont Co., R. H., Phila.
Detrick Co., M. H., Chicago
International Combustion Engrg. Corp., N. Y.
Jeffrey Mfg. Co., Columbus
Link-Belt Co., Chicago
United Conveyors Corp., Chicago
Ash Quenchers
Allen, Sherman, Hoff Co., Phila.
Ash Sluicing Systems
Allen, Sherman, Hoff Co., Phila.
Ash Tanks, Tile
United Conveyors Corp., Chicago
Baffle Walls, Boiler
Boiler Engineering Co., Newark
Engineer Co., N. Y.
King Refractories Co., Buffalo
McLeod & Henry Co., Troy, N. Y.
Page Contracting Co., Fred., N. Y.
Walsh Fire Clay Products Co., St. Louis
Baffles, Boiler
United States Refractories Co., Mt. Union
Baffles, Monolithic
Boiler Engineering Co., Newark
King Refractories Co., Buffalo
Quigley Furnace Specialties Co., N. Y.
Bearings
Argus Smelting Co., N. Y.
Magnolia Metal Co., N. Y.
Bearings, Thrust
Timken Roller Bearing Co., Canton
Bearings, Roller
Timken Roller Bearing Co., Canton
Belt Drives
Standard Oil Co. of Indiana, Chicago
Belting
Greene, Tweed & Co., N. Y.
N. Y. Belting & Packing Co., N. Y.
Quaker City Rubber Co., Wissinoming, Phila.
Rhoads & Sons, J. E., Phila.
Belting, Conveyor
Jeffrey Mfg. Co., Columbus
U. S. Rubber Co., N. Y.
Belting, Leather, Waterproof
Rhoads & Sons, J. E., Phila.
Belting, Rubber
Quaker City Rubber Co., Wissinoming, Phila.
U. S. Rubber Co., N. Y.
Bins, Coal and Ash
Blaw-Knox Co., Pittsburgh
Brown Hoisting Machinery Co., Cleveland
Blowpipes, Welding and Cutting
Oxweld Acetylene Co., N. Y.
Blowers, Centrifugal
De Laval Steam Turbine Co., Trenton
Elliott Co., Jeannette, Pa.
Graybar Electric Co., N. Y.
Jeffrey Mfg. Co., Columbus
Wing Mfg. Co., L. J., N. Y.
Blowers, Fan
Buffalo Forge Co., Buffalo
Clarage Fan Co., Kalamazoo, Mich.
Engineer Co., N. Y.
Graybar Electric Co., N. Y.
Jeffrey Mfg. Co., Columbus
Wing Mfg. Co., L. J., N. Y.
Blowers, Forced Draft
Air Preheater Co., N. Y.
Buffalo Forge Co., Buffalo
Clarage Fan Co., Kalamazoo, Mich.
Jeffrey Mfg. Co., Columbus
McClave-Brooks Co., Scranton, Pa.
Wing Mfg. Co., L. J., N. Y.
Blowers, Induced Draft
Buffalo Forge Co., Buffalo
Clarage Fan Co., Kalamazoo, Mich
Jeffrey Mfg. Co., Columbus
Blowers, Portable, Electric
Clements Mfg. Co., Chicago
Blowers, Soot for Boiler Tubes
Diamond Power Specialty Corp., Detroit
Huyette Co., Paul B., Philadelphia
Marion (Ind.) Mach., Fdry. & Supply Co.
Robertson & Sons, Jas. L., N. Y.
Vulcan Soot Cleaner Co., Du Bois, Pa.
Blowers, Steam Jet
McClave-Brooks Co., Scranton, Pa.
Blowers, Turbine
Coppus Engineering Corp., Worcester, Mass.
Elliott Co., Jeannette, Pa.
Ingersoll-Rand Co., N. Y.
Moore Steam Turbine Corp., Wellsville, N. Y.
Terry Steam Turbine Co., Hartford
Wing Mfg. Co., L. J., N. Y.
Boiler Compound
Garratt-Callahan Co., Chicago
Boiler Fronts
McClave-Brooks Co., Scranton, Pa.
Boiler Setting
American Chimney Corp., N. Y.
Ballard, Sprague & Co., N. Y.
Botfield Refractories Co., Phila.
Cement-Gun Co., Allentown, Pa.
CoKal Stoker Corp., Chicago
Custodis Chimney Constr. Co., Alphons, New York
Detrick Co., M. H., Chicago
Green Fire Brick Co., A. P., Mexico, Mo.
Illinois Stoker Co., Alton, Ill.
Keystone Refractories Co., N. Y.
Laclede-Christy, St. Louis
Obermayer Co., S., Chicago
Page Contracting Co., Fred., N. Y.
Plibrico Jointless Fire Brick Co., Chicago
Queens Run Refractories Co., Lock Haven
Reintjes Co., Geo. P., Kansas City,
Rust Engineering Co., Pittsburgh
United States Refractories Co., Mt. Union
Walsh Fire Clay Products Co., St Louis
Boiler Tubes
Reading (Pa.) Iron Co.
Boiler Tube Cleaners
(See Blowers, Soot, for Boiler Tubes)
(See Scale Removers)
(See Tube Cleaners Boiler)
Boilers, Heating
Stanwood Corp., Cincinnati
Boilers, Locomotive
Connelly Boiler Co., D., Cleveland
Boilers, Portable
Stanwood Corp., Cincinnati
Boilers, Return Tubular
Bigelow Co., New Haven, Conn.
CoKal Stoker Corp., Chicago
Connelly Boiler Co., D., Cleveland
Stanwood Corp., Cincinnati
Union Iron Works, Erie, Pa.
Vogt Mach. Co., Henry, Louisville
Walsh & Weidner Boiler Co., Chattanooga
Boilers, Waste Heat
Combustion Engineering Corp., N.Y.
Edge Moor (Del.) Iron Co.
Heine Boiler Co., N. Y.
Wickes Boiler Co., Saginaw
Boilers, Water Tube, Cross Drum, Horizontal, Inclined, Vertical
Babcock & Wilcox Co., N. Y.
Bigelow Co., New Haven, Conn.
Casey-Hedges Co., Chattanooga
Combustion Engineering Corp., N.Y.
Connelly Boiler Co., D., Cleveland
Edge Moor (Del.) Iron Co.
Heine Boiler Co., N. Y.
Kingsford Fdy. & Mach. Co., Oswego, N. Y.
Ladd Water Tube Boiler Co., Pittsburgh
Springfield (Ill.) Boiler Co.
Union Iron Works, Erie, Pa.
Vogt Machine Co., Henry, Louisville
Walsh & Weidner Boiler Co., Chattanooga
Wickes Boiler Co., Saginaw, Mich.
Books
McGraw-Hill Book Co., N. Y.
Breechings
Heine Boiler Co., N. Y.
Brick, Fire
Botfield Refractories Co., Phila.
General Refractories Co., Phila.
Green Fire Brick Co., A. P., Mexico, Mo.
Laclede-Christy, St. Louis
McLeod & Henry Co., Troy, N. Y.
Norton Co., Worcester
Obermayer Co., S., Chicago
Plibrico Jointless Fire Brick Co., Chicago
Queens Run Refractories Co., Lock Haven
United States Refractories Co., Mt. Union
Walsh Fire Clay Products Co., St. Louis
Brick, Fire, Cement and Mortar
Bartley Crucible Co., Johathan, Trenton
Quigley Furnace Specialties Co., N. Y.
Brick Systems, Fire
Reintjes Co., Geo. P., Kansas City,
Brushes, Motor & Generators
Speer Carbon Co., St. Mary
Bucket Carrier, Pivoted
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago
Buckets, Clam Shell
Blaw-Knox Co., Pittsburgh
Brown Hoisting Machinery Co., Cleveland
Link-Belt Co., Chicago
Buildings Portable Steel
Blaw-Knox Co. Pittsburgh
Bunkers, Coal
Allen, Sherman, Hoff Co., Phila.
Beaumont Co., R. H., Phila.
Brown Hoisting Machinery Co., Cleveland
Link-Belt Co., Chicago
Burners, Gas
Gas Combustion Co., Pittsburgh
Mettler Co., Lee B., Los Angeles
Peabody Engr. Corp., N. Y.
Burners, Oil
Bethlehem (Pa.) Steel Co.
Combustion Engineering Corp., N.Y.
Combustion Service Corp., Brooklyn
Engineer Co., N. Y.
International Combustion Engrg. Corp., N. Y.
Littleford Bros., Cincinnati
Peabody Engr. Corp., N. Y.
Todd Dry Dock Eng. & Repair Corp., Brooklyn
Burners, Powdered Coal
Fuller-Lehigh Co., Fullerton, Pa.
Illinois Stoker Co., Alton
Bushings
Argus Smelting Co., N. Y.
Graybar Electric Co., N. Y.
Magnolia Metal Co., N. Y.
Carbon Rods & Paste for Welding
Oxweld Acetylene Co., N. Y.
Castings, Brass and Iron
Neemes Fdry., Inc., Troy
Castings, Grey Iron
Fuller Lehigh Co., Fullerton, Pa.
Cement, Fire Brick
Botfield Refractories Co., Phila.
Green Fire Brick Co., A. P., Mexico, Mo.
General Refractories Co., Phila.
King Refractories Co., Buffalo
McLeod & Henry Co., Troy, N. Y.
Norton Co., Worcester
Obermayer Co., S., Chicago
Plibrico Jointless Fire Brick Co., Chicago
United States Refractories Co., Mt. Union
Walsh Fire Clay Products Co., St. Louis
Cement, High Temperature
Botfield Refractories Co., Philadelphia
Norton Co., Worcester
Quigley Furnace Specialties Co., N. Y.
Cement, Iron
Obermayer Co., S., Chicago
Smooth-On Mfg. Co., Jersey City
Cement, Pipe Joint
Key Boiler Equipment Co., E. St. Louis, Ill.
Smooth-On Mfg. Co., Jersey City
Central Station Construction
Stone & Webster, Boston
Chain Drive
Jeffrey Mfg. Co., Columbus, Ohio
Morse Chain Co., Ithaca, N. Y.
Philadelphia (Pa.) Gear Works
Chimneys (See Stacks)
Chemical Water Treating
Chicago (Ill.) Chemicals Co.
Clamps, Pipe
Smooth-On Mfg. Co., Jersey City,
Yarnall-Waring Co., Phila.
Clutches, Friction
Link-Belt Co., Chicago
Coal
Peale, Peacock & Kerr, N. Y.
Pittsburgh (Pa.) Coal Co.
Coal Crushers
American Pulverizer Co., St. Louis
Beaumont Co., R. H., Phila.
Brown Hoisting Machinery Co., Cleveland
Combustion Engineering Corp., N.Y.
Fuller Lehigh Co., Fullerton, Pa.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago
Coal Handling Equipment
Beaumont Co., R. H., Phila.
Brown Hoisting Machinery Co., Cleveland
Hunt Co., C. W., West New Brighton, N. Y.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago
Sauerman Bros., Chicago
Coating, Boiler Wall
Dampney Co. of America, Hyde Park,
Coating, Protective
Dampney Co. of America, Hyde Park
Quigley Furnace Specialties Co., N. Y.
Cocks, Brass & Iron Body
Homestead (Pa.) Valve Mfg. Co.
Walworth Co., Boston
Cocks, Gage
Huyette Co., Paul B., Philadelphia
Jenkins Bros., N. Y.
Nason Mfg. Co., N. Y.
Shaffer Co., J. E., Tulsa
Cocks, Steam
Dart Mfg. Co., E. M., Providence
Homestead (Pa.) Valve Mfg. Co.
Lunkenheimer Co., Cincinnati
Merco-Nordstrom Valve Co., San Francisco
Combustion Chamber, Back Arch
Detrick Co., M. H., Chicago
McLeod & Henry Co., Troy, N. Y.
Obermayer Co., S., Chicago
Walsh Fire Clay Products Co., St Louis
Combustion Control System
Hagan Corp., Pittsburgh
Smoot Engr. Corp., N. Y.
CO_2 Recorders and Flue Gas Analysis Instruments
Brown Instrument Co., Philadelphia
Huyette Co., Paul B., Philadelphia
Republic Flow Meters Co., Chicago
Commutator Compound
Ohio Grease Co., Londonville, O.
Compressors, Air
Allis-Chalmers Mfg. Co., Milwaukee
Chicago Pneumatic Tool Co., N. Y.
Ingersoll-Rand Co., N. Y.
Nordberg Mfg. Co., Milwaukee
Pennsylvania Pump & Compressor Co., Easton, Pa.
Sullivan Machinery Co., Chicago
Worthington Pump & Mchy. Corp., N. Y.
Compressors, Ammonia
Ingersoll-Rand Co., N. Y.
Compressors, Gasoline
Sullivan Machinery Co., Chicago
Compressors, Extraction
Sullivan Mchy. Co., Chicago
Condensers, Barometric, Combined, Jet, Surface
Alberger Heater Co., Buffalo
Allis-Chalmers Mfg. Co., Milwaukee
Bethlehem (Pa.) Steel Co.
Buffalo (N. Y.) Steam Pump Co.
Elliott Co., Jeannette, Pa.
Ingersoll-Rand Co., N. Y.
Nordberg Mfg. Co., Milwaukee
Schutte-Koerting Co., Phila.
Wheeler Condenser & Engineering Co., Carteret, N. J.
Wheeler Mfg. Co., C. H., Phila.
Conduits, Underground
American District Steam Co., N. Tonawanda
Graybar Electric Co., N. Y.
Consulting Engineers
Byllesby Engineering & Management Corp., Chicago
Stone & Webster, Boston
Controllers, Draft
Engineer Co., N. Y.
Controllers, Electric
Graybar Electric Co., N. Y.
Converters, Rotary
Elliott Co., Jeanette, Pa.
Converters, Synchronous
Elliott Co., Jeanette, Pa.
Conveyors, Belt
Beaumont Co., R. H., Phila.



CENTRIFUGAL MINE PUMPS

Built for endurance

The illustration shows three of the four 10 in. x 8 in. four stage bronze mine pumps installed by the Lehigh Valley Coal Co. in 1923. No repairs have been ordered since this installation was placed in service. Another example of still more enduring service is the 16 in. six stage bronze mine pump furnished the D. L. & W. Ry. Co. in 1909 which is still in service with the original Casings. Allis-Chalmers mine pumps may cost a little more at first but there is extra metal where needed and other special features which make for enduring service.

ALLIS-CHALMERS

MILWAUKEE, WIS. U. S. A.

Brown Hoisting Machinery Co., Cleveland
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago

Conveyors, Portable
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago

Coolers, Generator
Griscom-Russell Co., N. Y.
Spray Engineering Co., Boston

Coolers, Oil
Alberger Heater Co., Buffalo
Griscom-Russell Co., N. Y.

Coolers, Water
Vogt Mach. Co., Henry, Louisville

Cooling Plants and Ponds
Power Plant Equipment Co., Kansas City, Mo.
Spray Engineering Co., Boston
Yarnall-Waring Co., Phila.

Cooling Towers
Seymour, Jas. M., Newark
Wheeler Condenser & Engineering Co., Carteret, N. J.

Wheeler Mfg. Co., C. H., Phila.
Wiederholt Construction Co., St. Louis

Couplings, Flexible Shaft, Rigid, Shaft
Bartlett-Haywood Co., Baltimore
De Laval Steam Turbine Co., Trenton, N. J.
Jeffrey Mfg. Co., Columbus, O.
Nicholson & Co., W. H., Wilkes-Barre
Palmer-Bee Co., Detroit
Philadelphia (Pa.) Gear Works
Terry Steam Turbine Co., Hartford

Covering, Pipe & Boiler
Obermayer Co., S., Chicago

Cranes
Brown Hoisting Machinery Co., Cleveland

Cranes, Crawler Type, Locomotive, Gas and Steam
Link-Belt Co., Chicago

Brown Hoisting Machinery Co., Cleveland

Cut-Outs, Electric
Graybar Electric Co., N. Y.

Cutters, Boiler Tubes
(See Pipe Cutters)

Cylinder Boring Bars and Reboring
Underwood Corp., H. B., Phila.

Dampers
Clarage Fan Co., Kalamazoo, Mich.

Deaerators
Cochrane Corp., Phila.
Elliott Co., Jeannette, Pa.
Griscom-Russell Co., N. Y.

Dealers Machinery
(See Searchlight Section)
Belyea Co., Inc.
Delta Equipment Co.
Fuerst-Friedman Co.
Hobson, Russell B.
Lakin-Allen Electric Co.
Land, L. J.
Moore & MacDonald
National Power Machy. Co.
O'Brien Mchy. Co.
Power Plant Equipment Co.
Randle Mchy. Co.
Rockford Power Mchy. Co.
Ross Power Equipment Co.
Sachsenmaier, Geo.
Wickes Machinery Co.

Desuperheaters
Elliott Co., Jeanette, Pa.

Die Stocks
Curtis & Curtis Co., Bridgeport
Toledo (Ohio) Pipe Threading Mach.

Distilling Apparatus (Water)
Bethlehem (Pa.) Steel Co.
Griscom-Russell Co., N. Y.

Draft, Mechanical
(See Blowers, Fan)

Drainers, Low Pressure
Cochrane Corp., Phila.

Dressing, Belt
Rhoads & Sons, J. E., Phila.

Drills
Chicago Pneumatic Tool Co., N. Y.
Jeffrey Mfg. Co., Columbus, O.

Drop Forgings
Ingersoll-Rand Co., N. Y.
Vogt Mach. Co., Henry, Louisville

Dynamometers
Wheeler Mfg. Co., C. H., Phila.

Dynamos (See Generators)

Economizers
Alberger Heater Co., Buffalo
Green Fuel Economizer Co., Beacon, N. Y.
Power Specialty Co., N. Y.

Ejectors
Bethlehem (Pa.) Steel Co.
Chaplin-Fulton Mfg. Co., Pittsburgh
Elliott Co., Jeanette, Pa.
Penberthy Injector Co., Detroit

Electors, Air
Elliott Co., Jeannette, Pa.

Electric Generating Sets, Steam Turbine
Allis-Chalmers Mfg. Co., Milwaukee
Elliott Co., Jeannette, Pa.
Moore Steam Turbine Corp., Wellsville, N. Y.
Terry Steam Turbine Co., Hartford

Elevators, Bucket
Webster Mfg. Co., Chicago

Elevators and Conveyors
Beaumont Co., R. H., Phila.

Brown Hoisting Machinery Co., Cleveland
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago

Elevators, Factory
Ridgway & Fils Co., Craig, Coatesville, Pa.

Engine Generators
Elliott Co., Jeanette, Pa.

Engine Repairs
Underwood Corp., H. B., Phila.

Engineering Service
Stone & Webster, Boston

Engines, Corliss
Allis-Chalmers Mfg. Co., Milwaukee
Elliott Co., Jeanette, Pa.
Nordberg Mfg. Co., Milwaukee

Engines, Diesel
Bethlehem (Pa.) Steel Co.
Busch-Sulzer Bros.-Diesel Engine Co., St. Louis
Fairbanks-Morse & Co., Chicago
Lombard Governor Co., Ashland, Mass.
McIntosh & Seymour Corp., Auburn
Nordberg Mfg. Co., Milwaukee
Worthington Pump & Mchy. Corp., N. Y.

Engines, Gas and Oil
Allis-Chalmers Mfg. Co., Milwaukee
Busch-Sulzer Bros.-Diesel Engine Co., St. Louis
Chicago Pneumatic Tool Co., N. Y.
Fairbanks-Morse & Co., Chicago
Ingersoll-Rand Co., N. Y.
Sterling Engine Co., Buffalo
Worthington Pump & Mchy. Corp., N. Y.

Engines, Poppet-Valve
Elliott Co., Jeanette, Pa.
Erie City Iron Wks., Erie

Engines, Steam
Air Preheater Co., N. Y.
Allis-Chalmers Mfg. Co., Milwaukee
Chicago Pneumatic Tool Co., N. Y.
Clarage Fan Co., Kalamazoo, Mich.
Elliott Co., Jeanette, Pa.
Nordberg Mfg. Co., Milwaukee
Skinner Engine Co., Erie
Stanwood Corp., Cincinnati
Troy (Pa.) Engine & Machine Co.

Engines, Steam Una-Flow
Elliott Co., Jeanette, Pa.
Nordberg Mfg. Co., Milwaukee
Skinner Engine Co., Erie

Evaporators
Bartlett Haywood Co., Baltimore
Bethlehem (Pa.) Steel Co.
Griscom-Russell Co., N. Y.
Wheeler Condenser & Engineering Co., Carteret, N. J.

Exhaust Heads
American District Steam Co., N. Tonawanda
Hoppes Mfg. Co., Springfield, Ohio
Wright-Austin Co., Detroit

Expansion Joints
Grinnell Co., Providence
Griscom-Russell Co., N. Y.
Hoyt Metal Co., St. Louis
Wheeler Condenser & Engineering Co., Carteret, N. J.
Wheeler Mfg. Co., C. H., Phila.
Elliott Co., Jeanette, Pa.

Fans, Exhaust and Ventilator
(See Blowers, Fan)

Extractors, Oil and Grease

Fans, Forced Draft
Green Fuel Economizer Co., Beacon

Feed Water Treatment
Chicago (Ill.) Chemicals Co.

Filters, Feed Water, Pressure—Water
Cochrane Corp., Phila.
Elliott Co., Jeannette, Pa.
Griscom-Russell Co., N. Y.

Filters, Oil
Elliott Co., Jeannette, Pa.
Nugent & Co. Wm. W., Chicago

Filters, Oil Removal
Elliott Co., Jeanette, Pa.
Griscom-Russell Co., N. Y.

Filters, Oil System
Nugent & Co., Wm. W., Chicago

Fire Hydrants
Howard Iron Wks., Buffalo

Firebox Blocks
McLeod & Henry Co., Troy, N. Y.
Norton Co., Worcester
United States Refractories Co., Mt. Union
Walsh Fire Clay Products Co., St. Louis

Fittings, Ammonia
Greene, Tweed & Co., N. Y.
Vogt Machine Co., Henry, Louisville
York Mfg. Co., York, Pa.

Fittings, Steel
Pittsburgh (Pa.) Piping & Equip. Co.

Flanges
Dart Mfg. Co., E. M., Providence
Grinnell Co., Providence
Jeffersen Union Co., Lexington, Mass.
Jenkins Bros., N. Y.
Pittsburgh (Pa.) Piping & Equip. Co.
Power Piping Co., Pittsburgh
Vogt Machine Co., Henry, Louisville

Floats
Hercules Float Wks., Springfield, Mass.

Flooring, Fireproof
Irving Iron Wks. Co., Long Island
Tri Lok Co., The, Pittsburgh

Flooring, Non-Slipping
Irving Iron Wks. Co., Long Island
Tri Lok Co., The, Pittsburgh

Flooring, Open-Steel
Tri Lok Co., The, Pittsburgh

Flooring, Steel
Irving Iron Wks. Co., Long Island
Tri-Lok Co., The, Pittsburgh

Flooring, Ventilating
Irving Iron Wks. Co., Long Island
Tri Lok Co., The, Pittsburgh

Foundations, Machinery
Ballard, Sprague & Co., N. Y.

Fuel Oil Systems
Bethlehem (Pa.) Steel Co.
Combustion Engineering Corp., N. Y.
Combustion Service Corp., Brooklyn
Engineer Co., N. Y.
International Combustion Engr. Corp., N. Y.
Peabody Engr. Corp., N. Y.
Todd Dry Dock Eng. & Repair Corp., Brooklyn

Furnace Arches
Bigelow Arch Co., Detroit
Detrick Co., M. H., Chicago
Hofft Co., M. A., Indianapolis
McLeod & Henry Co., Troy, N. Y.
Norton Co., Worcester
Obermayer Co., S., Chicago
Queens Run Refractories Co., Lock Haven
United States Refractories Co., Mt. Union

Furnace Bottoms, Cast Iron Air Cooled
Allen, Sherman, Hoff Co., Phila

Furnace Construction
Cement-Gun Co., Allentown, Pa.
Plibrico Jointless Fire Brick Co., Chicago
Reintjes Co., Geo. P., Kansas City,

Furnace Linings
Botfield Refractories Co., Phila.
Cement-Gun Co., Allentown, Pa.
General Refractories Co., Phila.
Green Fire Brick Co., A. P., Mexico, Mo.
Keystone Refractories Co., N. Y.
Laclede-Christy, St. Louis
McLeod & Henry Co. Troy, N. Y.
Norton Co., Worcester
Obermayer Co., S., Chicago
Plibrico Jointless Fire Brick Co., Chicago
Queens Run Refractories Co., Lock Haven
United States Refractories Co., Mt. Union
Walsh Fire Clay Products Co., St. Louis

Furnace Walls, Water Cooled
International Combustion Eng. Corp., N. Y.
Power Specialty Co., N. Y.

Furnaces
Combustion Engineering Corp., N. Y.
Detroit (Mich.) Stoker Co.
Fuller Lehigh Co., Fullerton, Pa.
Illinois Stoker Co., Alton, Ill.
International Combustion Engineering Corp., N. Y.
McClave-Brooks Co., Scranton, Pa.

Furnaces, Bagasse & Wood Burning
Combustion Engineering Corp., N. Y.
Detrick Co., M. H., Chicago
International Combustion Engineering Corp., N. Y.
McClave-Brooks Co., Scranton, Pa.

Furnaces, Incinerator
Combustion Engineering Corp., N. Y.
International Combustion Engineering Corp., N. Y.
McClave-Brooks Co., Scranton, Pa.

Fuses
Graybar Electric Co., N. Y.

Gage Glass Guards & Shields
Buyette Co., Paul B., Philadelphia

Jenkins Bros, N. Y.
Wright Austin Co., Detroit

Gage Glasses
Jenkins Bros, N. Y.
Libbey Glass Mfg. Co., Toledo, Ohio

Gage Glass, Preserver
Morse Grate Bar Co., Providence

Gages, Differential, Draft, Liquid Depth, Pressure, Recording Vacuum, Water
American Schaeffer & Budenberg Corp., Brooklyn
Ashton Valve Co., Cambridge
Bailey Meter Co., Cleveland
Bristol Co., Waterbury
Brown Instrument Co., Philadelphia
Greene, Tweed & Co., N. Y.
Jenkins Bros., N. Y.
Peabody Engineering Corp., N. Y.
Republic Flow Meters Co., Chicago

Gages, Welding
Oxweld Acetylene Co., N. Y.

Gas Burning Equipment
Mettler Co., Lee B., Los Angeles

Gaskets
Advance Packing & Supply Co., Chicago
Garlock Packing Co., Palmyra, N. Y.
General Asbestos & Rubber Co., N. Carolina
Greene, Tweed & Co., N. Y.
Jenkins Bros., N. Y.
Quaker City Rubber Co., Wissinoming, Phila.
Smooth-On Mfg. Co., Jersey City, N.J.
U. S. Rubber Co., N. Y.

Gates, Coal & Ash Bin
Allen, Sherman, Hoff Co., Phila
Beaumont Co., R. H., Phila.
Brown Hoisting Machinery Co., Cleveland

Hunt Co., C. W., West New Brighton N. Y.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago

Gauges, Welding
Oxweld Acetylene Co., N. Y.

Grating, Steel
Tri Lok Co., The, Pittsburgh

Gears
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago
Philadelphia (Pa.) Gear Works

Gears, Double Helical
De Laval Steam Turbine Co., Trenton, N. J.

Gears, Reduction
De Laval Steam Turbine Co., Trenton, N. J.
Elliott Co., Jeannette, Pa.
Moore Steam Turbine Corp., Wellsville, N. Y.
Palmer-Bee Co., Detroit
Philadelphia (Pa.) Gear Works

Generating Sets
Elliott Co., Jeanette, Pa.
Fairbanks-Morse & Co., Chicago

Generators, Acetylene
Oxweld Acetylene Co., N. Y.

Generators, Electric
Elliott Co., Jeanette
Fairbanks-Morse & Co., Chicago
Graybar Electric Co., N. Y.

Goggles, Welding
Oxweld Acetylene Co., N. Y.

Governors, Pump
Atlas Valve Co., Newark, N. J.
Chaplin-Fulton Mfg. Co., Pittsburgh
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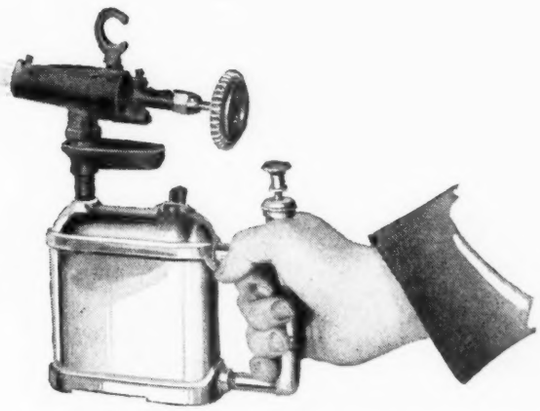
GARLOCK
TRADE MARK

1500° Fahrenheit



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In this we have been successful and are now offering to the trade Garlock-934 and Garlock-935 High Temperature Shredded Metal Packing. These mechanical packings are manufactured from high heat resisting metal floss bonded under pressure and impregnated with graphite. They will effectively pack against the highest of pressures and withstand heat up to 1500° Fahrenheit.

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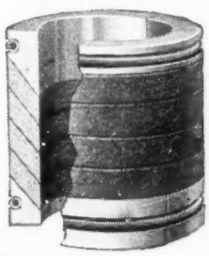
Garlock-935 is furnished in sets in ring form. Each and every ring is bevelled so as to fit into each other. All sets are made with bevelled end rings of superheat solid metal. Recommended for Piston Rods, Plungers and Valve Stems working against high temperatures and pressures. Also gives excellent service on Rods and Plungers of Hot Oil Pumps.



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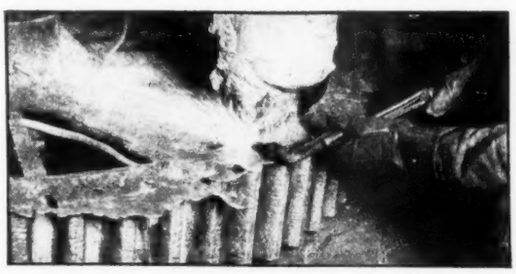

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Tanks
Cochrane Corp., Phila.
Heine Boiler Co., N. Y.
Littleford Bros., Cincinnati
Union Iron Wks., Erie
Walsh & Weidner Boiler Co., Chattanooga

Tanks, Copper
Hercules Float Wks., Springfield, Mass.

Thermometers, Controlling, Indicating, Recording
American Schaeffer & Budenberg Corp., Brooklyn
Bailey Meter Co., Cleveland
Bristol Co., Waterbury
Brown Instrument Co., Philadelphia
Moto Meter Co., Long Island City
Taylor Instrument Co.'s, Rochester

Torches, Welding & Cutting
Oxweld Acetylene Co., N. Y.

Tramways, Aerial
American Steel & Wire Co., Chicago

Transformers
Allis-Chalmers Mfg. Co., Milwaukee

Transmission Machinery
(See Power Transmission Mach.)

Traps, Air, Grease, Non Return, Return, Radiator, Steam, Vacuum
American Schaeffer & Budenberg Corp., Brooklyn
Armstrong Mach. Wks., Three Rivers, Mich
Atlantic Engineering Co., N. Y.
Cochrane Corp., Phila
Davis Regulator Co., G. M., Chicago
Ellis Drier Co., Chicago
Golden Anderson Valve Co., Specialty Co., Pittsburgh
Jenkins Bros., N. Y.
Morehead Mfg. Co., Detroit
Nason Mfg. Co., N. Y.
Nicholson & Co., W. H., Wilkes Barre
Powers Regulator Co., Chicago
Sarco Co., No., N. Y.
Schutte & Koerting, Phila.
Squires Co., C. E., Cleveland
Sterling Engr. & Mfg. Corp., Boston
Strong, Carlisle & Hammond Co., Cleveland
Templeton Mfg. Co., Boston
Wright-Austin Co., Detroit
Yarnall-Waring Co., Phila.

Tube Cleaners, Boiler
Lagonda Mfg. Co., Springfield, Ohio
Liberty Mfg. Co., Jeannette
Rosedale Fdry. & Mach. Co., Pittsburgh
Roto Co., Newark

Tube Cleaners Condenser
Lagonda Mfg. Co., Springfield, Ohio
Roto Co., Newark

Tube Cleaners, Water
Chicago Pneumatic Tool Co., N. Y.

Tube Cutters
Lagonda Mfg. Co., Springfield, Ohio

Tubes, Boiler
Babcock & Wilcox Tube Co., Beaver Falls, Pa.
Boiler Tube Co. of Amer., Pittsburgh
Reading (Pa.) Iron Co.
Tyler Tube & Pipe Co., Washington, Pa.

Tubes, Boiler, Charcoal Iron
Tyler Tube & Pipe Co., Washington.

Tubes, Boiler, Lap Welded
Tyler Tube & Pipe Co., Washington

Tubes, Condenser
Chase Co.'s, Waterbury

Wheeler Condenser & Engineering Co., Carteret, N. J.

Tubing
Boiler Tube Co. of Amer., Pittsburgh
Chase Co.'s, Waterbury

Turbines, Steam
Allis-Chalmers Mfg. Co., Milwaukee
De Laval Steam Turbine Co., Trenton, N. J.
Elliott Co., Jeannette, Pa.
Moore Steam Turbine Corp., Wellsville, N. Y.
Terry Steam Turbine Co., Hartford

Turbines, Water
Allis-Chalmers Mfg. Co., Milwaukee

Turbo Generators
Elliott Co., Jeannette, Pa.

Unions and Union Fittings
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Jefferson Union Co., Lexington,
Walworth Co., Boston

Valve Control, Electric
Liberty Electric Corp., Stamford.
Pittsburgh (Pa.) Valve Fdry. & Constr. Co.

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Jenkins Bros., N. Y.

Valve Operator, Electric
Liberty Electric Corp., Stamford

Valve Reseating Machine
Leavitt Mach. Co., Orange, Mass.

Valves, Altitude
Golden Anderson Valve Specialty Co., Pittsburgh

Valves, Automatic Air
Sterling Engr. & Mfg. Corp., Boston
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Valves, Automatic Cutoff
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Golden Anderson Valve Specialty Co., Pittsburgh

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National Valve & Mfg. Co., Pittsburgh
Pittsburgh (Pa.) Piping & Equip. Co.
Walworth Co., Boston

Valves, Bypass
Ashcroft Mfg. Co., N. Y.
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Valves, Check
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Jeffrey Mfg. Co., Columbus, O.

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Valves, Gate
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Pittsburgh (Pa.) Piping & Equip Co.
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Valves, Globe
Edward Valve & Mfg. Co., East Chicago
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Walworth Co., Boston

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Valves, Non-Return Stop
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Valves, Pump Rubber
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Wire, Welding
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Oxweld Acetylene Co., N. Y.

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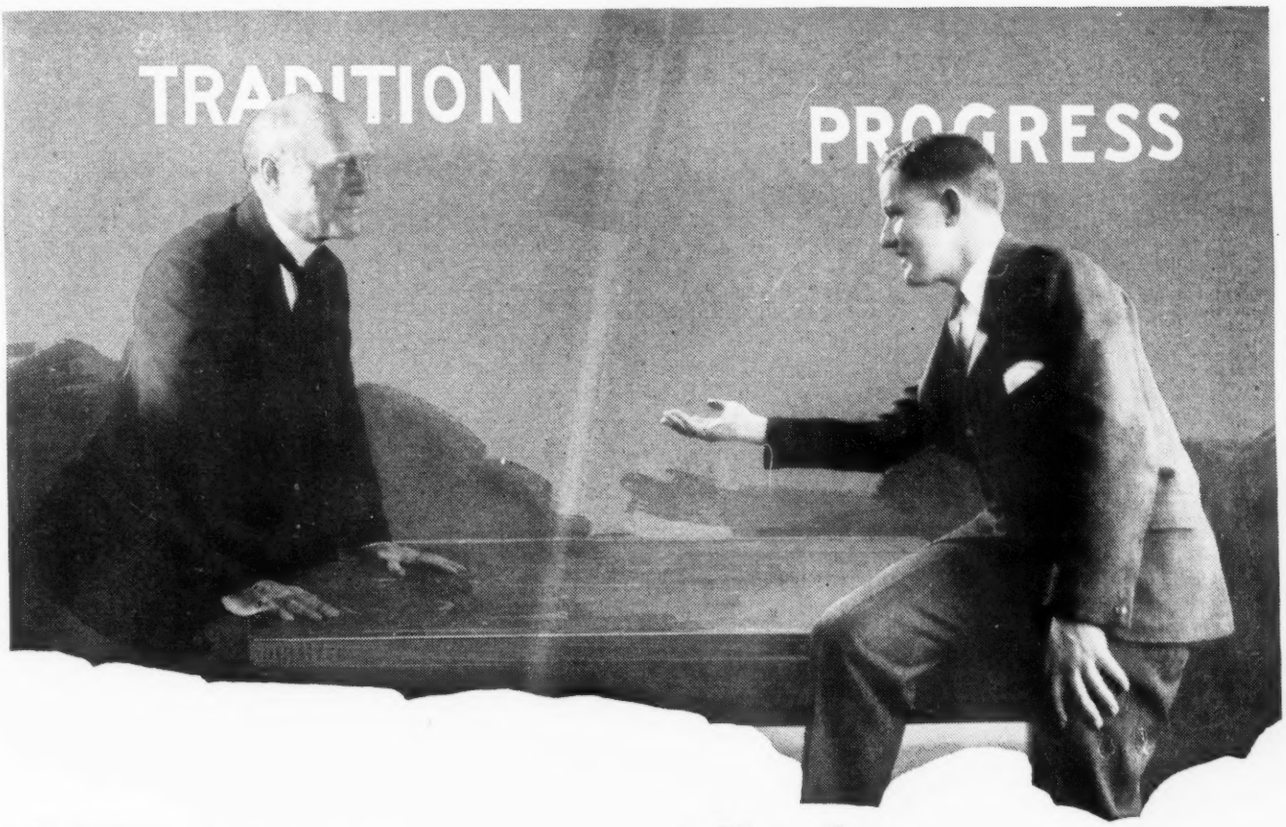
Walworth Co., Boston

Wrenches, Pipe
Walworth Co., Boston

Pop thinks all motors are alike



"Listen, Lad—

I was talking with my friend today about getting some more motors from him.

I told him all you've been saying about your pet welded-steel motor but he just smiled and said that you've been misled by 'talking points.' He admitted that all motors are basically the same."

"Yes, Pop—

and all men are born equal—but it's to their shame if they stay that way.

Specialized endeavor lifts a man out of the standardized class.

And that's just how the 'Linc-Weld' motor rose above its class.

Its whole engineering is directed to a single end: Motors.

And this development is sub-specialized into *Motors for specific purposes.*

If you want a pump motor — there's a 'Linc-Weld' motor for just that.

If you want an elevator motor — there's a distinct 'Linc-Weld' motor for just that.

If you want a motor for *any* duty—there is a distinct 'Linc-Weld' motor for just that.

Name your service and you get distinct, specialized, proved experience on that job exclusively.

Your friend's admission that all motors are born equal was over optimistic sales zest. 'Linc-Weld' motors are now in long pants instead of long whiskers."

The Lincoln Electric Co., Dept. No. 2-6, Cleveland, Ohio

MA-16

"Linc-Weld" LINCOLN MOTOR

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